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ESSAYS,

PHYSIOLOGICAL AND PRACTICAL;

FOUNDED ON THE

MODERN CHEMISTRY

OF

LAVOISIER, FOURCROY, &c. &c. &c.

WITH

A View to the Improvement

OF

THE PRACTICE OF PHYSIC.

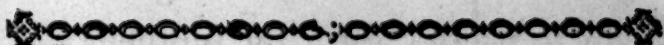
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1794.





ADVERTISEMENT.

THE writer of the following Essays,
owes great acknowledgments to the
author of the very ingenious Memoirs
presented to the Royal Academy, at
Paris, in the year 1787, on the very
exact and instructive experiments and
observations, in the present pneumatic
epoch of chemistry; from which a
theory has been established, not on hy-
pothesis, as many have been before,
but founded on experiments, proved
by weight and measure, in which matter
has been analysed to its first principles;

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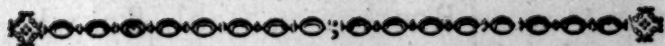
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and this same matter brought back again to its old form by synthesis.—a method hardly ever attempted to be done before, and a demonstration not to be doubted. After which, these authors observe, that in regard to truth, they are obliged to assert some things that may be contrary to our former ideas: Since which time, many philosophers have employed themselves in making fresh experiments and observations; so much that at present, these experiments and observations, have been universally received throughout Europe. From these authors he has also endeavoured to avail himself of what he thought to be material in physics; but, in these Essays, he has taken care to advance nothing but what has been confirmed by modern authors: at the same time he has pointed out
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some of the great and wonderful improvements that are likely to proceed from them, both in the physical and medical science. Hence, there is not a doubt, but that medicine, which has often been denominated vague and empirical, promises, by these assistances, to be as scientific as any one whatsoever.

F. PENROSE.





INTRODUCTION.

IN the following Essay, I propose to give a narrative of some of the late experiments in Chemistry, with observations on them; from which it may be observed, that by these, this science has put on an entire new appearance; because bodies have been more nearly analysed to their first principles, which I define to be Heat and Cold. These have been denominated first principles, because they were found to be of so subtile a nature as to evade all farther analysis, and their properties and powers were to be discovered, *only* from their effects.

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The first that began these improvements were, Boerhaave, Stahl, &c. who from their experiments, observed, that the light and heat, produced by the combustion of bodies, were the most subtile and powerful, and were the cause of most of the phenomena in nature; to this Stahl gave the name of Phlogiston, and he believed that every body contained Phlogiston; that it was discharged from that body during combustion; and that it was one of the first principles of bodies.

This set many curious and ingenious men to make experiments on this Phlogiston, but it did not become a regular theory till Mr. *Lavoisier* read his memoirs and published his experiments in the Royal Academy of Paris, on the 18th of April, 1787, wherein he proved that the idea of the matter of light and heat being disengaged from the body in combustion, was erroneous. On the contrary, Mr. Lavoisier made it appear that

that the light and heat were produced from the atmosphere, which being pressed on the outside of the body, during combustion, was there decomposed, one part, called by him Vital Air being absorbed, during which the matter of heat and light, which is one of the constituent parts of every elastic fluid, is separated, and thus rendered visible and sensible; by the pressure of more vital air, the same is continued, which being exhausted the combustion ceases, and no more heat and light can be produced.

The following is Mr. Lavoisier's account of combustion: "Combustion," says he, "is the decomposition of oxygen gas or vital air, produced by the combustible body. The oxygen which forms the base of this gas, is absorbed by and enters into combination with the burning body, while the caloric and light are let free; because combustion cannot take place, but in a certain degree of temperature, and then a dis-

disengagement of caloric and light ensues. But different substances require a different degree of temperature, which is different in each combustible substance; hence the necessity of the approach of a heated body. For nature is at present in a state of equilibrium, which cannot have been attained until all the spontaneous combustions, in the ordinary degrees of temperature, had taken place. Hence, no new combustions can happen without destroying this equilibrium, and raising the combustible substances to a superior degree of temperature: For let the temperature of the earth be changed to the degree of boiling water, in that case, phosphorus, which is combustible in a considerably lower degree of temperature, would no longer exist in its pure and simple state, but would be always in its acid or oxygenated state, by gradually increasing the temperature of the earth: the same circumstance would successively happen to all bodies capable

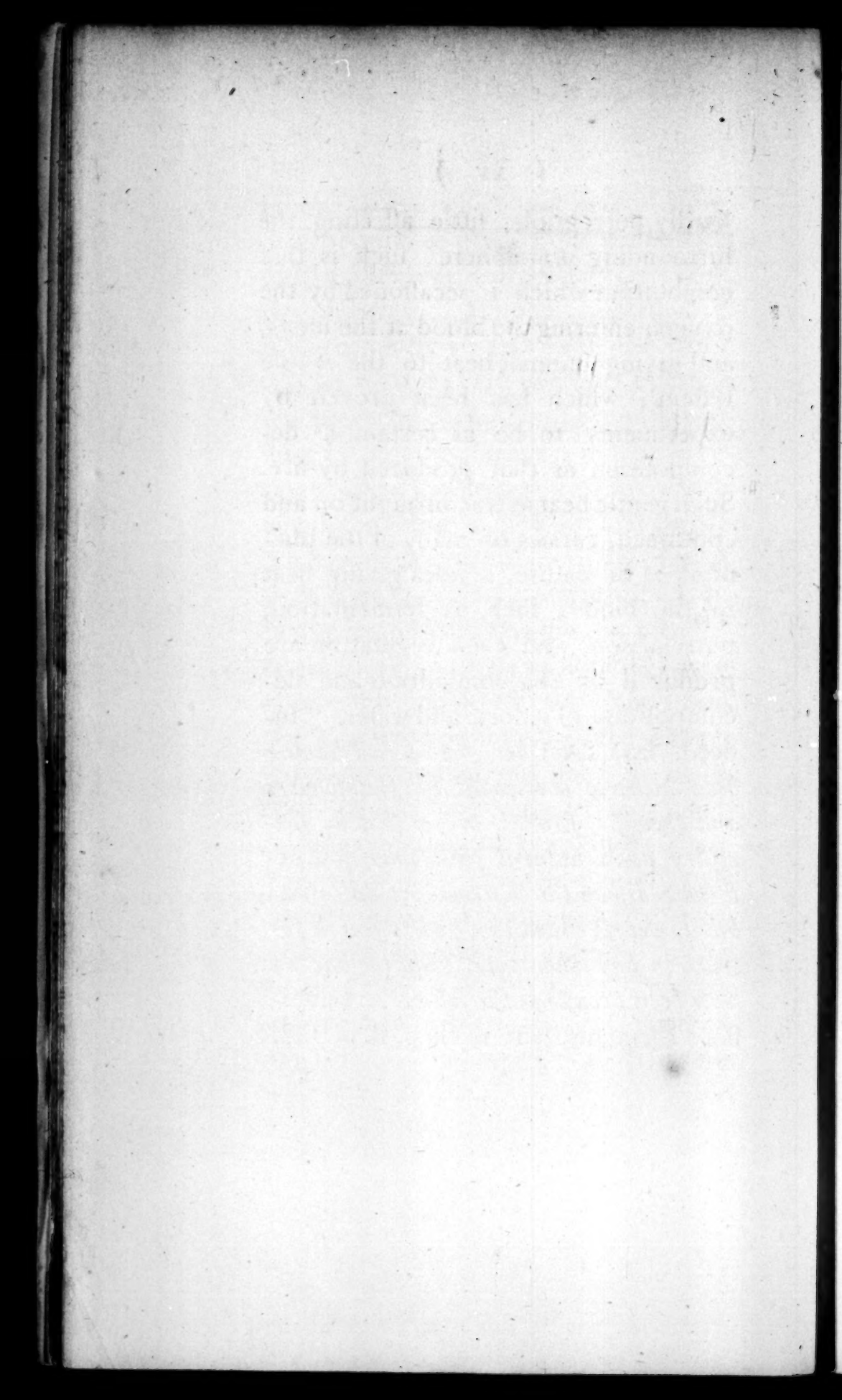
ble of combustion; and combustion having taken place, there would no longer exist any combustible body, except such as are incombustible in the ordinary temperatures of the earth. As it is essential to the nature of every combustible body, not to possess the property of combustion, unless heated, or raised to the degree of temperature at which its combustion naturally takes place, when this degree is once produced, combustion commences, and the caloric which is disengaged by the decomposition of the oxygen gas, keeps up the temperature necessary for continuing combustion : when the disengaged caloric is insufficient for keeping up the necessary temperature, the combustion ceases."

Combustion, or the conflict between heat and cold, appears to be the operation by which nature carries on the growth, life, and health of both animals and vegetables ; and the modern Chemistry has furnished some curious experiments to explain the nature of this

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action ; from which we may observe, that it is mild or powerful in proportion to the different degrees between these two powers. If the operation is brought on by a great heat, the action will be violent ; and continue less and less powerful till an equilibrium is produced. On the contrary, if it be generated when the two powers are nearly equal, the action will be soft and gentle. That curious experiment of Mr. Lavoisier's setting fire to a mixture of oxygen gas and hydrogen gas, by the electrical spark, gives us a tolerable idea of this operation ; for, in this experiment, the burning continues till the oxygen gas is decomposed and sent off in the shape of light and flame. Hence it may be observed that the combustion is performed by the caloric decomposing the oxygen gas, and fresh oxygen reacting and forcing off the caloric. When combustion is brought on and supported by these two powers, nearly in equilibrio, the operation is gentle, hardly

hardly perceptible, little affecting the surrounding atmosphere; such is that combustion which is occasioned by the oxygen entering the blood at the lungs, and giving animal heat to the whole system; which has been proved by experiments to be as certain a decomposition as that produced by fire. Such gentle heat as this brought on and continued, carries on many of the phenomena of nature, besides giving heat to the blood; such as fermentation, putrefaction, and even vegetation are produced by this combustion and decomposition of caloric and water. "Indeed," says *Lavoisier*, "*this fact having been hitherto overlooked by philosophers and chemists, strongly proves that in chemistry, as in natural philosophy, it is extremely difficult to overcome prejudices imbibed in early education, and to search for truth in any other road than the one we have been accustomed to follow.*" *Lavoisier's Elements*, part 1, chap. 8. p. 148.



CHEMISTRY.

ESSAY THE FIRST.

AS Chemistry appears to be one of the accomplishments of a physician, I think it proper to give some account of the late important discoveries therein, before I enter on physic. These discoveries are not founded on hypothesis, but from experiments and facts that are proved by weight and measure. For this last century, it has been a dispute between chemists and philosophers, whether the primary agents or powers in nature, were in solids or fluids. This dispute has also made a part in the healing art, both in anatomy and

and medicine. By the late discoveries in Chemistry, nature has been analyzed to her first elements ; it has been observed that most of the old philosophers have been of opinion, that notwithstanding the diversities of the bodies of nature, they are all composed of a few simple substances, which they call *principles*; the analysis of which has afforded the strongest facts in support of their doctrine of the powers being in fluids, and have afforded chemists a means to form accurate notions of the nature and differences of these principles ; when we analyze to these, we can go no further, but their powers may be observed by their effects ; these principles are found to be but two, heat and cold ; by the vibrations and oscillations of which, all the motions in nature are carried on and supported ; It is the nature of each of these two powers to attract or force itself into the place occupied by the other, and form the most uniform compound.

Heat

Heat is capable of existing in two different states; the one when it is set at liberty, by which its effects are rendered visible under the form of light and flame in the atmosphere, and likewise sensible to the thermometer. In the other state, it enters into the composition of bodies, forming one of their constituent principles, in which it is neither sensible to our feelings or even to the thermometer—this is called its latent state—hence the term of latent heat. *

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* We received but light information of what philosophers meant by *heat* and *cold*, any more than as their ideas affected our senses of feeling; many believing them qualities of something beyond their knowledge, not capable to be understood; with this they seemed satisfied. But the modern chemists having carried their enquiries to a greater extent, have analyzed matter to her first principles; and finding that heat and cold were substances not susceptible of further examination by our senses, have considered them as primary elements in nature, whose powers might nevertheless be observed by their effects on other bodies. They also observed, that these two powers were always acting in opposition, yet they had the greatest affinity for each other, always endeavouring at the closest union

The effect of heat is to diminish the specific gravity of bodies, by repelling the integrant particles of matter, by which they are all separated to a greater distance.

union till an equilibrium was formed; they observed that the parts of all bodies, both solid and fluid, were put in motion and made to act by these two powers; *Heat* causing expansion or repulsion between their parts, and *Cold* condensing or compressing their parts closer together, and causing them to attract to each other; heat causing action or motion of their smallest parts, till it was overcome by the powers of cold, when they were made to recede back again, but by a fresh addition of heat they were again able to expand; in this manner oscillation or action and reaction were carried on through all nature.—As it is not long since matter has been analyzed to her first principles, so it is but lately that we have obtained proper ideas of heat and cold; both being generally thought to be only qualities of something in nature, which we did not understand.—Few believed them to be more than modifications, and this was the celebrated Macquer's opinion; he believed fire to be so, and many of our modern chemists still imagine cold to be only a privation of heat. However, to prove that the modern chemists, by their experiments, think cold to be a power of nature, I will give you their account of it. The quantity and power of heat and cold has long been ascertained by that certain machine, the thermometer, which shews exactly the

distance from each other, and by this means is the bulk considerably augmented. Owing to this, the particles of matter suffer an internal motion which still

the *expansion* given to matter by heat ; and also on the contrary, the *compression* added by the cold ; and the modern chemists to explain in the clearest light, have given us the experiments of heat and cold on water ; on these they observe that water when the heat and cold of the surrounding air, is at 32, or the freezing point, becomes a solid ; add to it heat, and it becomes a liquid ; add more, and it is changed from a liquid to an aeriform gas ; after this, they shew us that by adding to it a sufficient quantity of cold, it returns again to water ; and by a fresh addition of cold, it again becomes a solid, at the very same point of the thermometer it was at first. But Mr. Fourcroy in describing the aerial aggregation, observes, “ that *what constitutes the peculiar nature of aerial aggregation is incapacity to pass into a fluid state ; by this however no more is to be understood, than that hitherto we have not been able to apply to it any degree of pressure, or cold sufficient to accomplish this effect.*” He informs us, in Vol. 1, p. 98, “ that the particles of bodies rarified by *heat* suffer an internal motion, which tends to divide them from one another ; and that *cold* on the contrary *compresses and condenses them.*” These chemists observe, that the laws of rarefaction are imperfectly known, but that it is of importance to know, *Fourc. Vol. 1. p. 162, 1st.* “ that bodies
always

still farther divides them, and thereby the attraction of aggregation is destroyed; and all such bodies pass from a solid to a fluid, and by an addition of more heat, from a fluid state to that of an invisible elastic gas, in which state it remains

always produce *cold*, when they pass from a solid to a fluid state. 2d. That fluids capable of assuming a concrete form, generate heat, as they become solid; in like manner, Vol. 1. p. 118, aeriform fluids, which may be denominated vapours, lose their elastic fluidity, by degrees of *pressure* or *cold*, which may be easily estimated, and readily communicate to the surrounding bodies that portion of heat, which constitutes them aeriform fluids." *Fourc.* vol. 1. p. 120, "Lastly, since *cold and pressure are the two means* by which elastic fluids are condensed, we may perhaps at length be able, by employing intense degrees of both, to reduce all these from their gaseous state, and to obtain their bases pure and separate, by expelling the substantial heat which maintains them in fluidity."

The above are the observations of the modern chemists in explaining the powers of heat and cold, as it is given by Mr. Fourcroy, in his elements of chemistry, which is the chemistry recommended by Dr. Black, of Edinburgh, to his pupils.

mains till cold restores to it part of its density and specific gravity*.

The property of the other element, cold, always acts in opposition to heat, which by its power, forces the parts of all bodies into closer contact, and adds to their specific gravity and attraction; these two powers being in constant oscillation are the cause of all motion. Thus the action and reaction of these two elements produce a continued internal motion in solids and fluids, to which we must have recourse, when we attempt to form an idea of any alteration in animal and vegetable substances, such as, of the circulation of the blood in animals, of the motion of the sap

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* Thus it is in our power to diminish the attraction of the particles of bodies almost at will, by heating them; that is, by introducing caloric into the interstices between the particles. Caloric is the repulsive cause which separates the particles of matter from each other; this subtile matter penetrates through the pores of all known substances; since there are no vessels through which it cannot escape.

in vegetables, and the mild combustion which conducts them to maturity ; and of the composition, the decomposition, the reciprocal changes, and the putrefaction of animals and vegetables.*

Thus, the modern experiments, prove from incontestible facts, that the parts of solids and fluids are made to repel each other by heat, and to contract or to attract nearer to each other by cold. These two powers, being elements or first principles, can only, however, be known by their effects.

A solid, ice, for example, being heated is converted into water, and this water when exposed to a heat of 212 degrees, takes the form of vapor ; cold being
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* A strong heat is usually employed in the operations of art ; but a gentle and continued heat, such as that which is exerted in the operations of nature, gives rise to a number of important phenomena, which are highly worthy of the attention of philosophers and chemists.

again applied, the heat will be expelled or pressed out, and by the time it has arrived at 32 degrees, it will return again to solid ice. The same may be said of almost all the substances in nature;—they are, *solid*, *fluid*, or *aeriform*, according to the degree of heat to which they are exposed, and the experiments in modern chemistry and physics have discovered the method of measuring exactly the comparative quantities of heat necessary to convert a part of the solid bodies into liquids, and these latter into aeriform elastic fluids.

We say then that gas, or an aeriform fluid, is a combination of *caloric* with some other substance; and every time there is a formation of gas, caloric is necessary; and reciprocally every time that a gas returns into a solid or liquid state, the quantity of caloric which had been required to render it gas, again appears, and is set at liberty. This is an incontrovertible fact!

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We do not deny the existence of caloric in solids; to pretend any such thing would be arguing against conviction; but we assert, that the same body contains more heat when in a state of fluidity, than it contained in a state of solidity, and also much more when advanced to the state of elastic fluidity.

By these discoveries in chemistry we have gained not only an accurate law of the principles of bodies, but also the affinity of composition: *Stahl* and many others, call this power, *attraction*, and have laboured to prove, that bodies never enter into composition, but in consequence of a certain relation or resemblance between their properties. By joining bodies of this kind you form an aggregate; but for two bodies to combine and form a compound, it is indispensibly necessary for them to be different in kind. Join two bodies of the same nature, and you form only an aggregate, of which the bulk and extent

tent are enlarged, but its essential properties remain unaltered; and their union is occasioned and preserved by the affinity of aggregation. Thus two pieces of wax, rosin, or sulphur, may be united by the action of heat. This instance is sufficient to explain the difference between aggregation and composition. These aggregate bodies have external qualities, such as weight, bulk, surface, extent, and figure; are perceptible to our senses, and may be estimated by their effects on them.

It is the business of chemistry to analyse both aggregates and compounds to their most minute particles, principles, or elements, till they evade all farther analysis, when these elements or powers can be known *only* by their effects. It is only after bodies have been reduced to a state of tenuity, by the several preparatory operations, that they become subjects to the affinity of composition: when they are brought to
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this state, it is found that it is indispensably necessary for them to be of different kinds. Chemistry has proved this to be an invariable law, and admits of no exception! This law holds so invariably, that the affinity of composition is never stronger, than when the bodies between which it acts are, in nature the most essentially different from one another. Thus heat and cold, the first two opposite powers in nature, unite with the greatest force till they form an equilibrium and genial compound.

Acids and alkalies (although the properties of the one are directly opposite to those of the other) enter into the *most intimate mutual combination*, and form the most perfect compound. The same opposition subsists between the properties of alkalies and sulphur, of acid salts and oil, of acids and metals, of water and spirit of wine, &c. All which substances have a strong tendency or affinity to mutual union. A re-
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gard for truth obliges us to point out these properties of bodies, which we derive from experiments, though they may be inconsistent with our former ideas.

The ancient philosophers supposed water, earth, fire, and air, to be the four elements ; but some of those are found to be far from being simple and unchangeable ; as air and water having been, by Lavoisier, decomposed into further principles, by which they must be necessarily deprived of their exclusive title of elements—yet this does not hinder us from considering them to have an influence on most of the phenomena of nature, and to exist in many of its productions.

Beccher and *Stahl*, by their experiments, appear to be the first who explained many of their chemical processes by *phlogiston* ; which doctrine has been farther improved by the labours
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of Drs. *Black*, *Priestley*, Mr. *Kirwan*, &c. but they had not agreed upon the nature of this phlogiston or its mode of action. It was first considered under the name of the inflammable principle or phlogiston; and by *Beccher*, as a fixed and heavy earth. Mr. *Macquer* in his last works, has totally abandoned this system, and has made his phlogiston a subtle principle; in a word, absolute light. Mr. *Beaumé* has adopted another opinion, or rather hypothesis, in some measure, intermediate between those of *Stahl* and *Macquer*. He regards phlogiston as a combination of fire with an earthy substance. This combination according to him, exists in an infinity of proportions, from which result different kinds of phlogiston, from the degree of pure fire, which is sensibly exempt from weight, to that of the most earthy phlogiston, which at the same time is the most heavy. This doctrine likewise is very different from that of *Beccher* and *Stahl*.

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By the labours of the French chemists, and owing to the greater perfection of their apparatus, the nature of this element has been of late much better understood, from a more exact analysis by which its properties are more completely ascertained; and although *Stahl*, *Macquer*, *Dr. Black*, &c. described phlogiston differently, yet the same matter was understood by the same name, which in the new chemistry, is denominated *caloric*. It is still the matter of fire, of flame, of light, and of heat, which is liberated in combustion; they only differ from *Stahl* in this, that this principle is not disengaged from the body in combustion; but, from their experiments, they endeavour to prove that it is liberated from the vital air or oxygen, during the combustion from the atmosphere. Yet it is still phlogiston, it is still the matter of heat; whether we call it phlogiston, *caloric*, or in plain English, *fire*.

The difference between Stahl and Lavoisier, appears to be, that Stahl thought the matter of fire and light was no other than the phlogiston which the body contained, and was let loose in combustion. If so, it is plainly an act of decomposition, in which the combustible body loses one of its principles. But how is it possible for a body, after having lost one of its component principles, to possess considerably more absolute weight than before? An hundred *lib.* weight of lead affords an hundred and ten of minium; and Mr. Lavoisier found that eighteen ounces of pure water are obtained, by burning sixteen ounces of spirit of wine. From the experiments which Mr. Lavoisier has made, he differs in opinion from Stahl, who thought that the matter of fire and light were no other than the phlogiston which the body contained, and was let loose in the combustion. On the contrary, Mr. Lavoisier thinks, that heat, light, and all other remarkable phenomena

mena of combustion, depend rather on a certain action of the air, than on the peculiar nature of the combustible bodies ; that the flame which then arises, is occasioned by the disengagement of light which was combined with the pure air, but not of that which existed in the combustible body.—He ascribes to pure air, that decomposition which, according to Stahl, took place on the inflammable substance.

Mr. Lavoisier observing that air is absolutely necessary to combustion, and that part of the air necessary to the calcination of metals, remains in the calces ; and that it promotes combustion by precipitating itself into the combustible body, and uniting with it, gives to the air thus precipitated the name of vital air : Thus, when a combustible body is exposed to the air and kindled, a portion of the vital air in the atmosphere becomes fixed in that body, and its combustion continues till it absorbs all the vital air immediately around it. The
residue

residue of the air, after it has lost the pure vital air, can no longer contribute to combustion. It regains this power on being again qualified with a due quantity of pure air extracted from nitre or any metallic calx. Thus, this elegant theory of Mr. Lavoisier appears to explain all the phenomena of combustion! It accounts for the additional weight acquired by metallic calces, and the extinction of flame by air that has already been employed in combustion. Mr. Lavoisier observing, that the bright sparkling flame seems rather to surround the exterior part of the body in combustion, than to proceed as if it were disengaged from it, has been led to think, that light and heat are separated from vital air, in proportion as it is absorbed by the body in combustion. His opinion is, that vital air, like all other aeriform fluids, is a compound, consisting of a certain principle susceptible of solidity, and of fire or the matter of heat; and that to the latter it owes its elastic

elastic state; and that, being decomposed in combustion, its fixed, solid principle, by entering into combination with the combustible body, increases its weight and changes its nature—while the matter of fire, the other component part, is disengaged under the form of light or heat. Thus the modern doctrine has attributed to vital air what *Stahl* did to phlogiston. If combustion consists in the disengagement of fire, it is the vital air, and not the combustible body, which is decomposed.

Mr. Fourcroy observes, that respiration is a phenomenon nearly resembling combustion. Common air is decomposed in the one as well as the other; in order for it to contribute to either, it must contain a certain quantity of vital air, of which when it is totally deprived the *mephitic* residue is fatal to animal life. Respiration, is in fact, but a slower combustion, in which part of the heat or caloric of the vital air enters the blood

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as it passes through the lungs, and is, by it, conveyed through the whole body. In this manner animal bodies receive their supplies of heat, which is absolutely necessary ; as they are constantly giving out the heat, which they contain, to the atmosphere and other surrounding bodies. To maintain the heat of the blood is, therefore, one of the chief purposes of respiration. This theory explains why the blood of those animals that respire either no air, or but very little, is always cold.

Owing to Stahl, and others, at first not agreeing upon the idea which ought to be applied to the word phlogiston, which they did not perfectly understand, they occasioned much confusion in the attributes given to it. The new chemists reflecting upon this, as well as on a multitude of other terms, which had been introduced by the alchymists, have seen the necessity of remedying this confusion, and accordingly have attempted

attempted a reform of the language of this science; for as there is so intimate a connection between facts and words, it would be improper to preserve a vicious nomenclature, when the science has been so much enlightened and simplified. For this purpose the modern authors have endeavoured to exhibit denominations which may point out the constituent principles of bodies.

All the former synonymous terms only served to retard the progress of chemistry;—and Mr. Lavoisier, and others, have thought that this reformation should be commenced by bringing the language to a state of purity, by introducing into the science a true taste and spirit for analysing.

The first class of principles analysed by the new experiments in chemistry appear to approach near to a state of simplicity, which makes them resist all all farther analysis. These are *two* in

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number, *oxygen* and *hydrogen*. The hydrogen comprehends light, matter of heat, and inflammable gas, commonly called caloric; the other is named *oxygen*, or vital air, whose basis comprehends latent cold.

Oxygen is simply that portion of the atmospheric air, which maintains respiration and combustion; but this portion of atmospheric fluid is not always in the state of air, or gas, but is decomposed in a great many operations, and loses at least in part, the light and caloric, which are what principally constitute it vital air. This substance should be considered and represented in the state of its greatest simplicity. The logic of the nomenclature requires even that it be named the first; that the word which would recal the idea become the model for the denominations of its compounds, acting agreeably to these conditions by adopting the word *oxygen*; deriving it, as Mr. Lavoisier

fier proposed, from the Greek words, *οξύς*, *acid*, and *γεννῶμαι*, *to beget*; on account of the property of this principle, (the basis of vital air,) to change a great many substances with which it unites into the state of acid, or rather because it appears to be a principle necessary to acidity. It unites with sulphur, and with phosphorus during their combustion, and to metals in their calcination.

On applying the same principles to the aeriform substance called *inflammable gas*, the necessity of having a more explicit appellation, is evident at the first view. It is true that this fluid is capable of being consumed; but this property does not exclusively belong to it, notwithstanding that is the only substance which produces water by its combustion with oxygen gas. This is the property which appeared to be the most worthy of affording a name, not for the gas itself, which is a compo-

tion, but for the more fixed principle which constitutes the basis, and we have therefore called it *hydrogen*, from *υδωρ* *water*, and *γεννομαι*, *to beget*, as water is the immediate production of the *combustion* of oxygen gas with hydrogen gas, deprived of the light and caloric which is disengaged during the combustion.

With respect to the name of phlogisticated air, it is now entirely laid aside. This name was originally given by Dr. Priestley, because he thought that it was atmospheric air, contaminated by being loaded with something which it received from the phlogistic or burning body—but late experiments have clearly shewn that this fluid is not formed or produced by the combustion, but that it is what already existed in the atmosphere, and that it is nothing more than atmospheric air deprived of that oxygen, which was precipitated into and absorbed by the burning body ;
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and as this air has the property of destroying animal life, we avoid the former unmeaning word, and assume a name which holds out to our mind that particular idea, by which the memory is much assisted; hence the word azotic or azot, from the Greek primitive alpha and Ζωη, signifying life. From these circumstances it will not be difficult to recollect, that the air which we breathe is a composition of oxygen and azotic gas.

All gasses owe their state of expansion to the caloric or matter of heat they contain.

It is, therefore, necessary that we distinguish in every kind of gas, the caloric which acts as a dissolver, and the substance to which it is united, and which forms the basis. Therefore vital air has its basis, and it is to that basis, we give the name of oxygen. In like manner we distinguish the basis of inflammable gas which we denominate hydrogen.

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One point of the modern doctrine, which appears to be most firmly established, is the formation, the decomposition, and the recombination of water; and how is it possible to doubt it, when we see that on burning together 15 grains of inflammable gas, and 85 grains of vital air, we obtain exactly 100 grains of water, and that by decomposition, we can again obtain these two principles, in the same proportions? The water which we obtain, was contained in the two airs, in the two elastic fluids, which we burned. After the conflict between the two airs, the *oxygen* and the *hydrogen*, the watery particles subside, and the oxygen basis is dissolved in the combustion with the hydrogen, and they both become azot in the top of the receiver, and are therefore of no weight*. This experiment shews

* Is not the vital air so far decomposed, as to become caloric in the top of the receiver, except a small quantity or the basis which is united with the water?

shews us, that oxygen by combustion with hydrogen, will be so dissolved and decomposed, as to unite with the caloric and become azot, and that the inflammable air was composed of caloric and water. Hence the receiver becomes filled with two elements *only*, viz. azot and water.

It has been proved, that in the calcination of metal, either under bell-glasses, or in vessels closely stopped, containing certain quantities of air, the air becomes decomposed, and the metal becomes augmented in weight by a quantity precisely equal to that of the air absorbed. It has been since discovered, that on performing the calcination of a metal in very pure vital air, this latter can be entirely absorbed, and that when the calcination is performed in vessels hermetically sealed, it is limited by the quantity of air contained in the vessels, and that the vessels themselves do not augment nor diminish
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in weight, during the operation. In fine, it has been observed, that the greater the rapidity of the calcination, the more sudden is the disengagement of caloric; and that in the calcination of iron, an absolute combustion takes place, when performed in pure air.

In the calcination of metals however we are not to understand that the vital air combines with the metals, for this explanation would not be sufficiently exact. But it is to be explained in this manner :—When the attraction of aggregation between the particles of the metal has been sufficiently diminished by the application of heat, so that its temperature is elevated, then does the chemical attraction take place, and the vital air becomes decomposed; that is to say, the basis or oxygen, owing to its greater attraction for the metal, than for the matter of heat or caloric, is precipitated into and absorbed by the calcining metal, while the other component part is set at liberty.

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This explanation of what happens in calcination, is not an hypothesis, but the result of absolute facts, and verified by numerous experiments.

In like manner there is a total absorption of the vital air, or rather of the *oxygen, which forms its basis* in the combustion of phosphorus; and the weight of the phosphoric acid obtained, is found to be exactly equal to the weight of the phosphorus and the vital air employed in the combustion. The same agreement of weight, is observed in the combustion of inflammable or hydrogen gas and vital air, in that of charcoal, &c. In all these operations, the caloric, which maintained the oxygen in a state of expansion, is liberated; yet with this *remarkable circumstance, that there is more caloric disengaged in the combustion of inflammable gas, than in that of phosphorus, because the two aeriform fluids mutually give it forth*; while, on the contrary, much less is liberated

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in the combustion of charcoal, because the result of this combination being carbonic acid or fixed air, there is a necessity for caloric to maintain it in its aeriform state; but the greatest part of the oxygen is dissolved into caloric.

These relations are far from being suppositions; for every thing is proved to conviction by weight and measure.

There is another experiment we ought to observe here, *viz.* the revivification of metallic calces in hydrogen, or inflammable gas, by the means of a burning mirror. If under a glass-bell or jar filled with mercury, and inverted over mercury, a pint, that is to say, two grains weight of inflammable gas be introduced, and to that be added a metallic calx, and upon this, the focus of a burning glass to be made to fall, the inflammable gas becomes totally absorbed; at the same time the metal revivifies, and a considerable quantity
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of water is deposited both on the sides of the bell and jar, and on the surface of the mercury. It has not yet been determined exactly what quantity of water is obtained in this operation; but it is at least proved, that it far exceeds the weight of the inflammable gas employed; therefore it could not have been contained in the gas; as eight or ten grains, or even more of water are obtained in this dissolution. But it was proved by the experiment of the combustion of oxygen air with inflammable air, that it required more than five times the quantity of oxygen, to one of the hydrogen; so here the two grains of hydrogen have dissolved, by the combustion, more than ten grains of oxygen, which remained in the calx after calcination; hence, more than eight or ten grains of water are obtained, on the liberation of the oxygen from the calx.

The experiment of mixing of oxygen gas and hydrogen gas, and the precipi-

pitiation of water by the combustion, give us an idea of the phenomena produced by a thunder storm, which appears to be occasioned by the meeting of clouds filled with oxygen and hydrogen gas ; from the conflict of which, fire or light is produced, and water precipitated.

The clouds are formed from water and other matters dissolved and subtilized by the heat of the summer, and thereby formed into a state of aeriform expansion or gas in the atmosphere ; these being of less specific gravity than the atmosphere, are forced by its weight or pressure to ascend higher or lower according to the temperature thereof. Some of these clouds will contain oxygen, while others will have little more than hydrogen ; by both these sorts floating in the air and meeting together, it may uniformly follow, that by the heat of the sun, a combustion and precipitation of their contents may take place,

place, in the same manner as we see performed in the glass receiver, between the oxygen and hydrogen, when fire is produced and water precipitated. This precipitation of the water from the clouds is generally forced against the wind. The cause of this water coming against the wind, may be explained from the natural properties of heat and cold; each making one effort to take the place of the other; the heat by opening, dividing, and expanding the cold parts; and the cold by forcing the heat before it, and contracting the parts into closer contact; and wherever there is the greatest difference between the degree of heat and cold, there will be the greatest struggle; thus, fire acts with the greatest violence where there is the greatest cold; and cold endeavours to force itself into the place occupied by the greatest heat.

It has been proved, beyond a doubt,
that the difference between cold and
heat,

heat, in different parts of the atmosphere, is the cause of wind; the cold air always endeavouring to force itself towards the part that is hottest; the heat also endeavouring to force itself into, and through the parts occupied by the greatest cold: if the heat succeeds, it opens a passage through it, and makes, comparatively, a vacuum, and the cold air tends to that vacuum with a strength proportionate to the difference between the heat and cold, and the suddenness with which the vacuum is made. Thus, at the meeting and combustion of these aeriform clouds, the heat and light produced thereby, forces itself into the place which the cold air occupied. This was the current of cold air forcing itself against the clouds, and thereby producing the wind.

On the combustion between these different airs, the sudden break of which produces thunder, and the light occasion-

occasioned by the combustion, forces itself into that cold current of air which occasioned the wind ; hence, a kind of vacuum is made, into which the water is forced, and descends to the earth through that vacuum ; the direction of which will be directly contrary to the former current of cold wind or air ; and this water descends with more or less violence, in proportion to the degree and suddenness of the fire occasioned by the combustion of the clouds. Thus, in hot climates, near the line, the vacuum is so great and complete, as to suffer the water to descend in perfect spouts.

By the means of recombination, we have been enabled to discover that water is a compound body, and to determine the nature of the principles which enter into its combination ; by this we assert, that water is a composition of the basis of vital air and that of inflammable gas, meaning oxygen and hydrogen.

hydrogen. For the component principles of water are again found by the analysis, in the decomposition of water ; so that in this argument we have the very utmost of chemical demonstration. We need only present to the water any substance that has a greater affinity with the hydrogen, the basis of inflammable air, or with the oxygen, the basis of vital air, to produce the separation of its constituent parts, the water becomes decomposed ; and the one of its principles, which does not engage in the new combination, unites with the caloric, and appears in the form of gas.

The great phenomena of the nutrition and growth of animals and vegetables, of the different kinds of putrefactions, &c. offer a multiplicity of examples of these decompositions.

ESSAY II.

HAVING in my last essay given as full an account of the modern system of chemistry, as far as it related to the animal œconomy, I shall now proceed to my second subject, viz. that of Life and Health.

For many years past, it has been the general opinion of philosophers and physicians, that the powers of nature were in solids, and that these consisted in a certain relation or resemblance of their properties; on which the new chemists make the following observation: “ A regard for truth, “ obliges us to point out these properties of bodies, which we derive from “ experiment, though they may be inconsistent with our former ideas.” They then go on to tell us, that by
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this system, the different parts of compound bodies have been analyzed to their first principles, which they found to be Heat and Cold; and that those can only be known by their effects, as they are of too subtile a nature to be observed by our senses.

The nature of these two powers are found to be quite opposite, yet they have such an affinity to each other, that it is their constant endeavour to unite, till a compound is formed of the most congenial nature. These two powers, acting always in opposition to each other, form a vibrating motion in all solids and fluids; hence proceed all motion, life, and health.

These experiments have shewn us, that all bodies must be reduced to the utmost tenuity, before their properties are found. When several preparatory operations have reduced them to this state, it is found indispensibly necessary
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for them to be of different kinds. Chemistry has proved this to be an invariable law, and admits of no exception. Thus, we find that the affinity of composition is never stronger than when the bodies between which it acts, are, in nature, the most essentially different from one another. Thus, heat and cold, acids and alkalies, acids and oil, acids and metals, water and spirit of wine, &c,

To these two first principles, they have given the following names; the first, *caloric*, the basis of which, is fire or heat; to the second, *oxygen or vital air*, the basis of which is latent cold. By these two powers all the operations in nature are carried on and supported. Action or motion is performed by heat entering the substance of all bodies, and expanding all their parts, overcoming the attraction of solids, and so dividing their parts as to change their form from a solid to a fluid; by a greater addition

of caloric, they are still farther expanded and subtilized, till they become a gas or elastic fluid, of less specific gravity than the atmosphere; by the pressure of which they are made to ascend contrary to gravity, till by the reaction of cold, the heat they contain is forced out, and their parts pressed closer together, till they again become solid.

If we examine animal and vegetable life, we shall find that life is brought on by these powers; and that afterwards life and health are supported by them: and farther, that all diseases are brought on and cured by these very powers; and that all the diseases attending the human constitution, may be reduced to two genera, *viz.* Hot and Cold; and that what causes one disease, is the cure of the other.

The first of these diseases is, occasioned by too great a quantity of caloric

loric or stimuli, and is denominated *stenic* or *phlogistic*, and occasions an *exhaustion* of the oxygen or irritability.

The second genus of diseases proceeds on the contrary, from a want of heat or stimuli, and is called *astenic*, not having stimuli sufficient to carry off the *excess* of irritability. Hence the oxygen or irritable principle accumulates in the fibre, and brings on a state of accumulation, from which proceeds debility.

Having premised thus much, I shall now enter on my essay on the animal œconomy, in which I shall point out when, and how life is brought on; by what it is supported; and the means, explained, how diseases are brought on and cured.

ON

ON LIFE AND HEALTH.

SECTION I.

Animal life appears to be generated from the vital air forcing itself into the lungs. Thus, as soon as the child is admitted to the atmosphere, the oxygen or vital air forces itself into the mouth, through the *trachea* into the lungs, dilates its vesicles, and by this means gets admittance into the blood; hence a combustion between the cold vital air and the warm blood; from which an expansion proceeds. By the power of this expansion, the blood is forced into the pulmonary veins, and from thence into the left ventricle of the heart, thence into the aorta, and so on through the arteries, to the surface of the body, and from thence back again through the veins to the heart; the manner of which will be described when the circulation of the blood is explained*.

* Mr. Fourcroy describes respiration in the following manner, as appears from the experiments in the new chemistry:

After the vital air has entered and expanded the lungs of a child, that child will not live many minutes, without the admission of fresh vital air. Thus it is probable, that many children may

chemistry: "Respiration," says he, "is but a slower combustion, in which the vital air is decomposed in the one as well as the other; by this decomposition, the heat enters the blood as it passes through the lungs, and is by it conveyed through the whole body. In this manner animal bodies receive their supplies of heat, which are absolutely necessary, as they are constantly giving out the heat which they contain, to the atmosphere and other surrounding bodies. To maintain the heat of the blood, is, therefore, one of the chief purposes of respiration."

Thus the experiments in the new chemistry, have not only discovered to us, how and in what manner heat is given to the blood, and distributed to the whole frame; but also what is the cause of the diastole of the heart. Anatomists to this time, have only told us that the heart performs a systole and diastole, from which the circulation of the blood is performed, but have not explained to us how this diastole and systole are occasioned. Indeed, there is not a doubt but the systole is performed by the contraction of the muscles of the heart, which is the only power that belongs to a muscle; and here the new chemistry

may be smothered before they are removed from their mother. Hence animal life being brought on by the admission of vital air, it will ever after require vital air to support it, together with meat and drink; it being now a complete animal.

Before the child was born and the vital air admitted, the circulation of the blood of the child was carried on together with that of the mother's, as will be explained hereafter, when we shew the difference of the anatomical parts of a child, before and after it has breathed: before that, it was a member belonging to the mother, and supported by her, as regular as any other member; but as soon as the air had forced

chemistry assists us, in letting us know that the diastole is performed by the expansive heat of the vital air entering the lungs, by which means the heart is filled with blood, and distended to a proper degree, to cause an irritability in the muscles of the heart, and thereby bring on the systole.

forced itself into the lungs, and expanded them, it became a complete animal; and able to be supported by meat, drink, and air, independent of the mother.

To give a farther proof that the child becomes a living animal, at the time, and in the manner above described, I shall, by an anatomical description, explain the make, the difference and use of the parts before and after the air has been admitted into the lungs.

In a foetus, the lungs are small, compact, of a colour like liver, and will sink in water, provided they are every way excluded from taking the atmosphere into their spongy substance; but in making the experiment, as the life of the mother often depends on the report of the surgeon, he ought not to determine hastily, whether the child has breathed or not; as an emphysema

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or putrefaction, will make them specifically lighter than water, so as to swim.

In the primary foetus there is no right ventricle to the heart; but there is so large an opening of the right auricle into the left, that all the blood which comes by the vena cava, passes into the pulmonary artery, *which instead of going into the lungs*, and from thence into the left ventricle of the heart, *is directly continued into the ductus arteriosus, which is larger than the capacity of both the pulmonary branches together, and greatly larger than the foramen ovale.* By this mechanism, an overcharge of the blood is turned off from the lungs and directed in a straight course to the *ductus arteriosus*. This is the reason why the aorta in a foetus is so small, at its coming out of the heart.

As the foetus grows larger, the lungs increase in size, and the passage from the right auricle into the left is narrower,

rower, the auricular canal is taken into the heart, and the auricles themselves, are become shorter ; but the septum joining the right and left auricle is perforated with a broad oval foramen ; through which the blood coming from the abdomen, flows in a full stream, into the cavity of the left auricle. As the foetus increases to maturity, a membrane now grows gradually, and fixes itself to the pulmonary sinus, above the foramen ovale ; so as, at first, to close a small and then a greater part of the foramen, so that only a transverse oblique passage remains. The valve in a mature foetus is so large, that when it is impelled by the blood from the left side, the valve, like a palate or shutter, closes up the foramen. Hence, as soon as the child breathes, and the blood passes through the lungs into the left auricle of the heart, it shuts and prevents the passage of the blood into the right auricle. After the child is born and breathes, the *ductus arteriosus*,

shrinks up and closes ; and in adults it appears only as a short ligament, adhering at one end to the aorta, and at the other to the pulmonary artery.

From the above description, it may be observed, that the nourishment of the foetus from conception to its birth, is conveyed by the umbilical vessels ; which are two large umbilical arteries, which after various twistings and windings, arrive at the *placenta*, whose substance is entirely made up of their branches, in conjunction with those of the corresponding veins. By these branches the blood seems to pass out through the minute arteries of the placenta into the veins of the maternal uterus, that after undergoing the action of the lungs of the mother's respiration, it may return again *in an improved state* to the foetus. In this manner the circulation of the blood is carried on between the mother and the foetus ; till the air has entered, and distended the lungs,

lungs, when it enters the blood and gives it life and heat, and the child becomes a complete frame, capable to live without the mother. Now, as it wants no more of the mother's blood, after it has breathed, the membrane entirely closes the foramen ovale ; which, had it remained open, would have prevented the blood coming from the lungs, by the pulmonary veins, from entering the heart.

Having explained when and how life is brought on, in the following essay, I shall endeavour to trace out the means nature makes use of for its support ; by which enquiry we shall find, that the things necessary thereto are meat, drink, and air ; and first of

AIR, OR ATMOSPHERE.

SECTION II.

The air or atmosphere, should be so far pure, as not to be loaded with
effluvia

effluvia noxious or hurtful to health. It is also necessary that it should be of a proper medium between heat and cold, adapted to our habit; as a little too much heat or cold, will bring on first predisposition, which by being continued and increased, disease will follow. Whenever this happens to be the case, the cure is to be performed by making use of, or removing to such an air as is of a contrary nature, till a proper medium is found. If the disease has been brought on by too much heat, the disease will be *stenic*, and will require a cooler air to increase the oxygen. On the contrary, if it was brought on by too cold an air, the disease will be *asthenic*, and require a warmer for its cure. But care should be taken that these removals from hot to cold, or on the contrary cold to hot, should not be sudden or extreme, but by gentle degrees till health is attained.

Nothing is better adapted for the removal

moval of chronic or asthenic diseases, than a proper and pure air; which either alone or conjoined with proper exercise, will greatly contribute to a cure. Heat stimulates, and cold debilitates; but a moderate and pure air gives and preserves health.

Thus, health consists in an easy, pleasant, and exact use of all the functions of the animal frame, and is supported and made to continue by a pure atmosphere, with a just mixture of heat and cold, adjusted to the habit: a little too much of either, will bring on predisposition, and then disease.

Predisposition is the middle state between perfect health and disease; for it seldom follows that the former, immediately, alters to the latter. The knowledge of predisposition to disease is of great importance, by enabling the physician to prevent or cure the disease which was likely to follow it. General diseases

diseases are always preceded by predispositions; therefore, when a physician is consulted during the predisposition, that disease may often be removed with little difficulty; whereas was it suffered to continue and increase till it becomes a disease, it may be attended with danger.

When the cure is undertaken, the transition should be by gentle and slow degrees; for the more intense the cold is, the greater is the accumulation of irritability. After the fibre has been exposed for some time to a great degree of cold, its irritability is increased to such a degree, that the most trifling degree of heat produces the most violent effects. It is by the gradual application of the heat, that frozen limbs can be recovered, and it is always necessary to begin by rubbing them with snow; without this, the fibre will be exhausted and become gangrenous.— During the winter, by the absence of
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the stimulus of heat, and in part light, plants and many animals become torpid ; the organs of circulation and nutrition perform their functions with languor, and life itself appears suspended ; in consequence of the diminished action of this stimulus, the irritability accumulates, and manifests itself, at the return of spring, when the least degree of it then produces the most violent effects upon the fibres thus delicately irritable. Animals, which had concealed themselves under ground, venture forth from their subterraneous retreats ; plants put forth their leaves and flowers ; and man himself is sensible of the stimulus of heat in the gales of spring ; his fibres having been rendered more irritable by the winter's cold. Vegetation is much more vigorous in spring-time than during the rest of the year ; it diminishes during the summer in proportion as its irritability, which was accumulated during the winter, is diminished by the action of heat

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and light ; and, lastly, is exhausted in autumn.

Naturalists have long observed the influence of light on vegetation ; and that the colour of herbs is pale or deep, in proportion as they are less or more exposed to the rays of the sun ; and that such as grow in the shade are of a paler colour ; and herbs growing under stones are quite soft, aqueous, and insipid. Gardeners have taken the advantage of this circumstance to supply our tables with white and tender herbs and plants ; for they bind up their leaves, so closely together, that the exterior defend the interior from the contact of the light.

When we want to alter the temperature of the air on account of health, it must be done, as has been already observed, by slow degrees ; because as the irritability of the fibre accumulates by the abstraction of heat, a very small
stimulus

stimulus then applied is sufficient entirely to exhaust or destroy it.

The constitution, by slow degrees, may be brought from a very cold climate to live in a hot one; for when it is done in a gentle manner, it will assimilate itself to the climate, which will become *habit*; for the irritable fibre is in a ratio compounded of the degree of its irritability, and the tone of the stimulus.

It is observed, that animals may be habituated to enjoy health in an air, heated, according to Fahrenheit's thermometer, from 30° to 100 : hence the medium most agreeable and healthy, seems to be about 65° , the difference between the two extremes; and about 30° or 40° the greatest number of degrees that the human frame will bear a quick transition of without danger.

Dr. Cullen tells us, that the natural

temperature of the human body is 98 degrees; and that every degree of temperature less than that, may be considered as cold, with respect to the human body; and in proportion to its degree, will have a tendency to diminish the temperature of the body. But as the living human body has in itself a power of generating heat, so it can sustain its own proper heat to the degree above mentioned, though surrounded by air or other bodies of lower temperature; and, says he, it appears, *from observation*, that in this climate, air, or other bodies applied to the living man do not diminish the temperature of his body, unless the temperature of the bodies applied be below 62 degrees. From hence it appears, that the absolute power of cold in this climate, does not act upon the living body, unless the cold applied be below the degree just mentioned.

From the above observation of the
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great Cullen, it may be observed that 62 degrees, according to Farenheit's thermometer, appear to be the most proper for health ; therefore, if we remove a patient from a colder, to a warmer temperature, on account of health, it should be to such an one that the temperature should exceed 62 degrees ; or, if we want to make a removal from one that is too hot to a colder, it should be to one of a lower temperature than 62. This rule will also hold good to regulate the temperature of the air with regard to such diseases as require a less or greater degree of heat, or cold.

Having finished my observations on air, which, if properly attended to, will generally relieve chronic diseases, and be a great means to preserve health, I shall now proceed to those

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ON FOOD AND DRINK.

SECTION III.

As I began this Essay on Life, at the moment a child was born, and when the animal life commenced, so I purpose to begin my observations on such food as is most proper for a child; and then proceed to what is stronger, and contains more stimuli. The mother's milk is most natural, and best adapted to young children. Before the child is weaned, he should be used, as much as possible, to other food; such as, gruel made with rice, or oatmeal mixed with milk; panada, that is, bread and water boiled to a consistence, potatoes, bread pudding, &c.; and, as he gets stronger, he may be used to fish, and animal food of easy digestion.

The highest state of debility, or asthenic diathesis, requires a greater circumspection

spection with regard to food, than healthy young children. This is brought on by starving, the want of food, or the absence of the stimulus of meat and drink. This disease is to be removed by food, both liquid and solid; if it has been carried to a great degree, great caution is required in administering them; as there are many instances of persons, who, not having eaten any thing for many days, have been intoxicated and killed, in consequence of swallowing, with great greediness, two or three cups of broth; the irritability of the system being so much increased by the abstraction of the stimulus of nutriment. The cure should be begun by giving the most diffusive stimulants in very small doses, to be repeated often: At first, it will be proper to give a small spoonful of warm wine and water, with two or three drops of *tinct. opij*, to be repeated every quarter of an hour, for two or three doses; after which a spoonful of warm broth: these

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to be given occasionally, till the different vessels of the body have received some stimuli and support, to enable them to perform their functions : after this, food of greater nourishment, and such as stimulates more, may be administered, till he recovers to the former state of health which he had before this accident.

A very small quantity of the common stimulus (nutriment) is required to supply the daily losses ; the greatest portion is employed in depriving the stomach, and of course the whole-system, of its irritability : hence, all animals are more irritable before than after food. Hunger, in the least degree, is caused by the accumulated irritability in the system. The gastric juice, acting upon the fibres of the stomach, it becomes more irritable, and produces the sensation of hunger. It is possible to do almost wholly without nutriment, by applying some other stimulus

mulus to the stomach, as opium, alcohol, coffee, tea, &c. by these means exhausting the accumulated irritability. It frequently happens in the East-Indies, that when the crop of rice fails, there are millions of men who support themselves by a small quantity of opium.

Having now explained the powers of the atmosphere, of heat, cold, meat, and drink, in support of life, and health; I come now to explain the œconomy of the human system, established by nature for that purpose.

OF DIGESTION AND THE CIRCULATION of the BLOOD.

SECTION IV.

Both the pain of hunger and the pleasure of gratifying the appetite, excite us to the performance of an action

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absolutely necessary for our support, *viz.* the taking in a due portion of aliment, in order to counterbalance the waste of the body by insensible perspiration, and other evacuations. Hence we are solicited to take food, both from the sense of pain from hunger, and the pleasure received by the taste. Appetite is brought on by the strong contractions of the fibres of the stomach, and the excretion of gastric juice, which irritates the coats of the stomach, and produces hunger. After meat and drink are taken into the stomach, they there meet the gastric juice; which meeting the vital air carried into the stomach with the food, brings on a slow combustion in the contents of the stomach, by which operation they are heated and dissolved.

This combustion, brought on between the gastric juice and the vital air carried into the stomach with the food, seems to be the means by which digestion

tion is carried on. As the combustion takes place on the outside of the food only, that part, as soon as it is digested, is pushed out at the pylorus. Hence the gastric juice comes in constant contact with the remainder of the food and vital air; and thus it continues till all the food in the stomach is digested.

Mr. Hunter has observed the following remarkable circumstance concerning digestion, *viz.*—That no part of a living animal can undergo the operation of digestion so long as the vital principle remains in it; but when that is gone, the digestive materials will digest even the stomach itself. “Hence it is, says he, that we find animals of various kinds living in the stomach, or even hatched and bred there; but the moment that any of these lose the living principle, they become subject to the digestive powers of the stomach. If it were possible, for example, for a man’s hand to be introduced into the stomach

of a living animal, and kept there for some considerable time, it would be found that the dissolvent powers of the stomach could have no effect upon it; but, if the same hand were separated from the body, and introduced into the same stomach, we should then find, that the stomach would immediately act upon it. Indeed, if this was not the case, we should find that the stomach itself ought to have been made of indigestible materials; for, if the living principle was not capable of preserving animal substances from undergoing that process, the stomach itself would be digested. But we find, on the contrary, that the stomach which at one instant, that is, while possessed of the living principle, was capable of resisting the digestive powers, which it contained; the next moment, *viz.* when deprived of the living principle, is itself capable of being digested, either by the digestive powers of other stomachs, or by the
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remains of that power which it had of digesting other things.

“ When bodies, says he, are opened after death, a considerable aperture is frequently found at the greatest extremity of the stomach. In these cases, the contents of the stomach are generally found loose in the cavity of the abdomen, about the spleen and diaphragm. In many subjects, this digestive power extends much farther than through the stomach. I have often found, that, after it had dissolved the stomach at the usual place, the contents of the stomach had come into contact with the spleen and diaphragm, had partly dissolved the adjacent side of the spleen, and had dissolved the stomach quite through ; so that the contents of the stomach were found in the cavity of the thorax, and had even affected the lungs in a small degree.”

Does not this difference of the power
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of resisting digestion, proceed from the different quantity of caloric, that is contained in one and the other. The vital heat in a living man is about 98 of Farenheit's thermometer, and the heat of the dead flesh about the heat of the atmosphere. The most proper heat to carry on fermentation is between 66 and 73, which is at least 25 degrees less than the heat of the body of a living man : perhaps this digestive heat may not have power sufficient to overcome the living principle, though fully sufficient to digest dead flesh.

With respect to the muscular coats of the stomach, they seem to act in the following manner : The fibres of these are partly longitudinal, and partly oblique, approaching to circular ; as the food is taken in, the former is contracted and shortened, by which they raise the under part of the stomach, which is unfixed, upwards.—As digestion goes on, and the food is converted
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into a more fluid form, this operation lessens the distending weight of the food downward; and it is thereby more collected in the under part of the stomach, which gives a pressure in the lateral way, and throws the other fibres into contraction, by which the sides of the stomach are squeezed together; and therefore perform the office of throwing out by the *pylorus*, the remaining part of the alimentary matter.

The aliments being thus driven into the *duodenum*, there meet the influent bile and pancreatic juice, which assist to complete digestion, by adding these solvents to the food already partly digested; they are then by the peristaltic motion of the intestines propelled forward along the intestinal tube*.

* The peristaltic or vermicular motion of the intestines is carried on in the following manner:—They have two muscular coats, in the same manner as has been described in the stomach; the external one has longitudinal fibres, and the internal oblique or nearly circular, downward.

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In this manner the alimentary pulp is formed into a froth, and enters the *jejunum* and *illium* or small intestines, from which the nutritious and volatile parts of the digested food, enter the lacteals in the form of an elastic gas, and then conveyed to the receptaculum chyli, or thoracic duct, which is a cyst formed for receiving the chyle from the intestines, and also the lymph from all parts of the body: in this cyst they are deposited, and from thence sent into the blood, just before it enters the heart. The use of the chyle is allowed by all to give stimulus and nourishment to the system.

When the digested food is sent into the guts, from the stomach, it is a warm frothy substance; from which arises a steam, which keeps the small guts distended; from this action, the oblique circular fibres are distended and the longitudinals shortened; till, by this irritation, the muscular fibres contract, and force the contents of the guts downwards, the uppermost first, then the next, till they thus go through the whole length of the intestinal canal: after this contraction, they are again distended, when the fibres react, and cause the vermicular motion downwards as before.

system. The lymph is secreted from all parts of the body, and carried into the thoracic duct, from which it enters the blood at the left subclavian vein, together with the chyle, and is conveyed to the vena cava, and from thence to the right auricle and ventricle of the heart; from thence into the pulmonary artery, by the branches of which it is distributed, from larger into smaller vessels, till it enters the interlobular substance, which surrounds the ramifications of the bronchiæ and blood vessels, from whence the carbonic air is discharged; when this happens, a vacuum is formed, and the atmosphere by its pressure, is forced through the bronchia into the lobules of the lungs, and from thence into the cells and vesicles; and from thence into the interlobular substance, till it meets the exhalent arteries which open into them. The vital air here enters the blood, and mixes with the chyle and lymph, which have just entered the lungs; hence a combustion

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bustion and decomposition of the vital air comes on, whereby heat and redness are given to the blood*. This combustion between the vital air and the aeriform chyle in the lungs, is brought on after the same manner, as we see performed between the vital and inflammable air, in that curious experiment mentioned in the former Essay; thus, the vital air is decomposed and dissolved into water and caloric; the caloric giving heat, and the water nutriment to the blood.

To prove that the oxygen, which is admitted into the blood at the lungs, gives heat and colour to the blood, I shall relate two or three experiments made by the sagacious *Dr. Girtanner*.

First,

* That oxygen or vital air gives a redness to the blood, is confirmed, by the redness given to meat, by saltpetre; which is a salt full of oxygen, and the only salt containing oxygen, that will give a redness to meat.

First, Six ounces of black blood, taken from the jugular vein of a sheep, were introduced into a vessel filled with oxygen air, and in an instant, the blood assumed a vermilion colour ; the thermometer within the vessel rose several degrees, but sunk again immediately.—The mercury in which the vessel was placed rose from six to eight lines; when the experiment was finished, the blood was increased a little in weight ; but though I am certain of this increase of weight, from repeated experiments, I cannot exactly ascertain how much it was; because the instruments I made use of for this purpose, were not sufficiently exact for so delicate an experiment.

From the above experiment it may be observed, that during respiration, the oxygen absorbed into the blood by the lungs, gives it a vermilion colour, with an addition of weight; and that during the absorption, heat was produced: this was proved by the most exact instru-

ment, the thermometer, and was also confined, by the expansion of the mercury, in which the vessel was placed.

Second, The jugular vein of a sheep was opened, and the blood which flowed from it was received in a glass bottle, filled with oxygen air; the bottle when half full was closed. The blood which it contained, immediately assumed a vermilion colour, became fluid, and coagulated but slowly, into a reddish and thick mass, without any separation of serum.—This experiment is a confirmation of the first.

Third, A considerable quantity of pure oxygen air, was injected into the jugular vein of a dog; the animal raised most terrible cries, breathed very quick, and with the utmost difficulty; by little and little his limbs became hard and stiff; he fell asleep, and died in less than three minutes; upon opening the thorax and pericordium, the heart was found

found more irritable than ordinary, and its alternate contractions and dilatations continued upwards of an hour. The right auricle of the heart was of a vermilion colour, and it contained, as well as the right ventricle, a great quantity of blood of a bright vermilion colour, frothy, and not coagulated. The blood contained in the left ventricle, in the aorta, and the arteries, was of a rose colour, and was mixed with bubbles of air; all the muscles were more irritable than ordinary; after the blood contained in the heart and veins was discharged, the irritability of the heart and muscles sensibly diminished.

This experiment proves most decisively, that the vermilion colour which the blood assumes in passing through the lungs, proceeds from the combination of oxygen, with the blood; that the livid colour of the venous blood, in the right auricle and ventricle of the heart was changed to vermilion. That
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this experiment is a direct proof that the oxygen is the principle of irritability ; for by furcharging the blood with oxygen, the irritability of the blood was considerably increased. It may also be observed that the surcharge of oxygen had the same effect on the dog, as the cold has on a person who is frozen to death ; it first occasioned stiffness in the muscles, then sleep, then death. The bubble of air shews us, that a combustion was caused by it.

Fourth, A small glass tube was filled with arterial blood of a bright vermilion colour, it was sealed hermetically, and exposed to light. The blood changed its colour by degrees, and in six days became as black as venous blood.

The same experiment was repeated, with this difference only, that the tube was exposed to heat, and not to light ; the blood became black in a shorter time.

time. So far then have I described the digestion of the food, and the manner in which the oxygen is transmitted to the blood, when a combustion and expansion are produced by the power of which the blood is sent to the heart and lungs; also the manner the oxygen is there transmitted into the blood, when a combustion and an expansion are formed by the power of which the blood is sent into the heart.

Before we point out the method nature makes use of for the circulation, it will be first proper to examine the make and use of the heart, and what part of that operation belongs to it.

The power of the circulation of the blood has been generally, and almost totally, attributed to the power of the heart. A great and most celebrated anatomist, in describing the uses of the heart, tells us, "That the heart, and the parts belonging to it, are the principal

cial instruments of the circulation of the blood. The two ventricles, says he, ought to be considered as two fyringes, so closely joined together as to make but one body, and furnished with suckers, placed in contrary directions to each other; so that by drawing one of them, a fluid is let in, and forced out again by the other *."

The comparison between the ventricles of the heart, and two fyringes joined together, may be just; as we know, that the two ventricles of the heart have as much power to suck the blood, as a fyringe has to draw in water; but we want to be informed, what are the powers that force the blood into the heart. We know, that by drawing up the piston of a fyringe, a vacuum is made in the barrel of the fyringe, and then the pressure of the atmosphere forces the water into that vacuum; but what

* Monro's Anat. 2d ed. vol. ii. p. 29.

what the power is, which causes the ventricles of the heart to act, he has not described any farther than that the blood is pushed out of the heart by the contraction of the ventricles, which is called the *systole*, and pushed into it by the auricles which is called the *diastole*. Whilst the powers of nature were supposed to be performed by solids, this, perhaps might be the best account given of the powers of the heart and the part it takes in the circulation of the blood; but, by the late exact and curious experiments in the new chemistry, material bodies have been analyzed to their first principles, and have shewn us that the first principles in nature, are the most subtile, active, and fluid; and that these first principles are two in number, Heat and Cold; and that by adding heat to any body, you expand that body, and put its internal parts in motion.

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I shall therefore enquire, what power the heart has, according to these principles, in the circulation of the blood; from whence it proceeds; and how it acts.

The heart is a muscular body, accompanied by two appendices called auricles, and by large blood vessels; it is hollow within, and divided by a septum into two cavities called ventricles; one of which is thick and solid; the other thinner and softer. This latter is generally termed the right ventricle, the other the left ventricle. Each ventricle opens at the basis by two orifices; one of which answers to the auricles, the other to the mouth of a large artery; one of them may be called the *auricular orifice*, and the other the *arterial orifice*. The right ventricle opens into the right auricle, and into the trunk of the pulmonary artery; the left into the left auricle, and into the great trunk of the aorta.

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The fleshy or muscular fibres, of which the heart is made up, are disposed in a very singular manner; being either bent into arches, or folded into angles. The fibres which are folded into angles are larger than those which are only bent into arches. The middle of these arches, and the angles of the folds, are turned toward the apex of the heart, and the extremities of the fibres towards the basis. These fibres differ not only in length, but in their directions, which are very oblique in all; but much more so in the long and folded fibres, than in the short ones, which are singly bent. The longest of these fibres form the most external stratum on the convex side of the heart, and partly the most internal on the concave side; the middle of these angles meeting obliquely and successively to form the apex. The fibres situated within these long ones grow gradually shorter and straiter all the way to the basis of the heart, where they are very short, and very

little incurvated. By this disposition, the sides of the ventricles are very thin near the apex of the heart, and very thick towards the basis. Each ventricle is composed of its proper distinct fibres; but the left ventricle has many more than the right, its substance being considerably thicker. Where the two ventricles are joined, they form an impervious septum, which belongs exactly to both.

. There is this, likewise, peculiar to the left ventricle, that the fibres which form the innermost stratum of its concave side, form the outermost stratum of the whole convex side of the heart, which consequently is common to both ventricles.

From the above anatomical description of the heart, we find it to be made up of two bags contained in a third, and that it acts in the same manner as other muscles; therefore, to know the
power

power of the heart, it will be proper to examine the nature of muscles, and how they act.

OF A MUSCLE.

In every animal and vegetable fibre, even in hair, feathers, membranes, the cellular texture, and in the humid fibre; in short, in animal and vegetable gluten, there is a contractile or elastic power, which preserves the fibre in the natural state, preventing it from being too much extended, and restoring it again to its proper dimensions, when the stretching power is removed: this power never ceases endeavouring to bring the elementary particles into the closest contact, that the mechanism of the part can admit. It is the nature of this power, to act continually by gentle but uninterrupted efforts.

Every muscle is composed of long soft threads or fibres, somewhat elastic,
or

or extensible, and almost constantly disposed parallel to each other; and these being surrounded with a good deal of cellular substance, are by that fastened together into little bundles, which are again tied together into larger bundles; and between these, we constantly perceive membranous partitions, and stripes of the cellular substance, removing them farther from each other; till at last a number of them combined together, are surrounded with a more thin and dense cellular membrane, continuous with that of their partitions; and this being again surrounded by a thicker plate of the cellular substance, parts the whole bundles from the adjacent flesh, and gives it the denomination of a *single* or *entire muscle*. The generality of the muscles have other fibres fixed to them; but these are condensed into a more slender, hard, and shining substance of a silver colour, which has the name *tendon*.

The natural action of the muscles is contraction;

contraction;—this is occasioned by a stimulus on the nerves; and as the nerves are distributed to every part of the muscle, so a stimulus to any part of the muscle, will cause a contraction.

The nerves enter the muscles, in a way somewhat similar with that of the arteries and veins; are divided into branches; but it is impossible to trace them a great way among the fleshy fibres, for they at length deposit their harder covering, and become soft, and disappear before they can be traced to their terminations. Thus, a stimulus applied to a muscle, will make it contract involuntarily; by this action a part of the nervous fluid, which the muscle contained, will be expended; but that expence will be soon repaired by more of the nervous fluid sent thither for that purpose, by the *vis medicatrix naturæ*, when that muscle will be again ready for action as before. In this manner the involuntary motions of the
body

body are carried on. This power of involuntary contraction, may be called *vis insita*, and will remain in a muscle after it is separated from the body, which will contract by every repeated stimulus, till the nervous fluid is quite exhausted.

As the heart is a muscle, and having considered how muscular motion is performed, we shall be able to explain what part the heart performs in the circulation of the blood. By the above inquiries, we observe that the power of the heart in common with other muscles, has only the capacity of contraction, which proceeds from the elastic force of the fibres; and that this contraction is brought on by stimulus; and that during contraction, a part of the nervous power is wasted, which must be again renewed from the brain, or else the *vis insita* will lessen every time it acts, and soon cease.

Having

Having described the power of the heart, we shall now proceed to relate the manner in which the circulation of the blood is carried on ; which narrative was brought on from the taking the food into the stomach, to meeting of the chyle and oxygen in the lungs ; from which mixture it has been observed, a combustion comes on, which produces an expansion, heat and colour to the blood.

Hence by this expansion, the blood is forced into the left auricle and ventricle of the heart, and continues to flow till it has filled the heart to such a degree, as by its stimulus it compels the fibres thereof to *react* and to contract, and thereby to force it into the aorta, which muscular coat *reacts* on the blood in the same manner as the heart ; thus the wave is carried on from artery to artery, till it arrives at the surface of the body, and terminates in the exhalants, appropriated for discharging carbonic
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fluid, which is continually passing off by insensible perspiration, when the person is in health. Here they meet the capillary veins, with which they form a kind of net work on the surface, with the arteries ; when the remaining power of the blood, and the coats of the vessels, together with the pressure of the atmosphere, force the arterial blood into the veins, and from these, into those that are larger and larger, till it arrives at the vena cava, and from thence to the heart ; after which it goes on the same rounds as have been already described.

From what has been observed, we may infer the following axioms : First, That for an animal to enjoy perfect health, he must be surrounded with an atmosphere of a proper temperature ; that is, it must neither be too hot, nor too cold ; too dry, or too moist ; and free from noxious effluvia. Some animals require a different temperature
from

from others ; nay, it is observed, that some men or women require to be surrounded with air of a different temperature according to their *habit* ; for the habit of one person, may differ from that of another ; indeed, the habit of the same person will differ at different times ; hence a person in too cool an atmosphere, should be removed to one that is warmer, or *vice versa* from warm to cool.

2. Besides being placed in a proper atmosphere, after a time, a due degree of nourishment of meat and drink, will be required ; the stimulus of which must be neither too much or too little : if it be too little, diseases of debility will follow ; if the quantity is too large, it will fill the constitution too much, and bring on a stenic diathesis. But if all these things are justly proportioned to the habit, good health will be the consequence, and the person will be able to enjoy all the functions with pleasure.

ESSAY III.

ON DISEASES.

SECTION I.

IN the former Essays, I treated on life, as it was brought on, at a child's first entrance into the world ; after that, in what manner life was carried on and supported ; and the requisites necessary for its preservation. In this Essay, I shall endeavour to trace out the diseases attending the human frame, together with their causes and cure. From which enquiry, we shall find that they are brought on and cured by the same powers, which brought life to the child, and supported health afterwards, *viz.* by the atmosphere, containing heat, cold and moisture, together with nourishment of meat and drink. We shall also find, that all diseases, both of animals and vegetables, may

may be formed into two classes *only*, viz. Heat and Cold : as this may seem paradoxical to those who have not reflected on the subject, it is nevertheless true, and will appear by convincing proofs, in the following Essay.

Thus, we may observe, that the irritable or contractile fibre, when separated from the animal or plant, preserves its irritability for some time, and continues to contract, upon the application of stimuli. It also retains this property, when cut into small pieces ; each piece continues, for a certain time afterwards, to contract ; which proves that the smallest portion of fibre possesses its own peculiar irritability, independent of other portions. The fluids in animals and vegetables are endued also with this property, as well as the solids. Their irritability consists in their coagulability, which is subject to the same laws as the irritability of the fibre : this, says Dr. Girtanner,

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is a new discovery; and it forms the basis of many important truths. The degree of irritability of both solids and fluids is constantly changing; it varies according to the age and habit of the same animal and the same plant. It is encreased by the absence of the common and habitual stimuli, and is weakened by the too frequent application of the same stimulus, or by the application of a stimulus too powerful. We may distinguish three different states of the irritable fibre, or three different degrees of irritability of which it is susceptible.

1st. The *state of health*, which is peculiar to each individual, and which may be called the *tone* of the fibre.

2d. The *state of accumulation*, produced by the absence of the habitual stimuli.

3d. The

3d. The *state of exhaustion*, produced by too powerful operation of stimuli.

The state of health, or the *tone* of the fibre, consists in a certain quantity of the irritable principle necessary to its preservation: to maintain this state, the action of the stimulus must be strong enough to carry off from the fibre the surplus of this irritable principle, which the lungs and the circulation of the fluids are constantly supplying. For this, a certain equilibrium is necessary, between the stimuli applied, and the irritability of the fibre: in fine, that the sum of all the stimuli acting upon it, may always be nearly equal; powerful enough to carry off from the fibre, the excess of its irritability, and not so strong as to carry off more than this excess. It is in this equilibrium between the acting stimuli, and the irritability furnished by the lungs and the circulation, that the *health* or the *tone* of the fibre consists. When the sum
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of the stimuli acting upon the fibre, is not great enough to carry off all its excess of irritability, the irritable principle accumulates in the fibre; and then it is found in that state which I call a *state of accumulation*. When the irritable principle accumulates in the fibre, its irritability is augmented, and the stimuli produce much stronger contractions than when the fibre only retains its tone. When the sum of the stimuli acting upon the fibre is too great, the fibre is deprived not only of the excess of its irritability, but also of some portion of the irritable principle necessary for the tone of the fibre; or, more properly speaking, the fibre loses more irritability than it receives, and of course in a short time finds itself in a *state of exhaustion*; and this will be either *temporary* or *irreparable*.

In a state of *temporary exhaustion*, the fibre loses its tone, and fails for want of irritability. The application of a stimulus,

stimulus, whilst it is in this state, will not make it contract. Provided the stimulus be not very strong, it will produce no effect at all; but, in a short time, the irritable principle will accumulate afresh in the fibre, and then it will contract. It is only by *little and little* that the fibre recovers its irritability.—This truth, I dare venture to say, is as new as it is striking: it unfolds a vast number of phenomena hitherto inexplicable. Let us observe, for example, the motion of the heart: the heart contracts from the stimulus of the blood, and impels the blood through the arteries; it then again dilates, and the blood enters. But the heart does not contract itself immediately upon the first impression of the blood: Its irritability having been lessened by the preceding contraction, it requires half or three quarters of a second before the irritability of the heart shall have accumulated to such a degree, that the new stimulus can act upon it.

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Any stimulus which is always present, and continually acting upon the fibre, produces no sensible effect, until the exhausted irritability of the fibre shall have been accumulated afresh. The periodical motions in organized bodies depend on the alternate exhaustion and accumulation of the irritability of the fibre. A total or irreparable exhaustion of the fibre consists in a total loss of its irritability; as in the case of gangrene. The fibre changes its colour, becomes dark or black, and subject to the laws of inorganic matter, and begins to decompose and putrefy.

A very powerful stimulus will in a very short time reduce the fibre to this state.

Amongst the known *positive stimuli*, which produce the greatest effects, are the stimuli of putrid fever, or the plague, and that of the mephitic or azotic gas, which exhales from burial places,

places, wells, large vessels of strong liquors, &c. : as soon as this *azotic gas* comes in contact with the fibre, it deprives it of its oxygen, and causes death frequently in an instant. The best way to prevent the fatal effects of this gas is to detonate nitre upon burning charcoal ; nitre is found to contain a large quantity of oxygen, which no other salt does. The oxygen gas which escapes during the decomposition of the nitre, supplies the oxygen, which combines with the mephitic air ; this theory is so true, that the workmen who have been suffocated by the mephitic air or azotic gas, have recovered their senses, and been refreshed as soon as they have been made to respire oxygen air.

As the above effect is occasioned by the *positive* stimuli, in like manner the *negative* stimuli has as violent effects ; thus some of the most terrible poisons must be ranked under this class. The

oxygen which combines with the organized fibre, when it comes in contact with these poisons, renders it so extremely irritable, that the weakest stimulus is capable of producing death; oxygenated marine acid, is for this reason, so fatal a poison to all organized bodies, it destroys them by furcharging them with irritability, and becomes marine acid.

When the irritable fibre has lost its tone, and fails either from an excess of irritable principle, or from a deficiency of this principle, it is *diseased*; and the system of which it forms a part, suffers and becomes diseased; thus, as has been before observed, all diseases of animals or vegetables may be ranged under two heads; to wit, first, the *diseases of accumulation*, caused by too great a quantity of the irritable principle or oxygen, which I term latent cold, and by the diminished action of the habitual stimuli, *heat*. Secondly, the *diseases of exhaustion*,

tion, caused by a defect of the irritable principle proceeding from the encreased action of the habitual stimuli, or from the addition of new stimuli; under these two classes may be ranged all diseases whatever: when the disease is that of accumulation, remedies, such as wine and opium, remove the disease by exhausting the fibre of its oxygen or irritability, to which principles I have given the appellation of latent cold. When the disease is from exhaustion, these remedies, such as nitre, acids, &c. are to be applied, which diminish the action of the common stimuli. Those stimuli which I call common and habitual, because they act continually more or less upon the *irritable fibre*, are *heat*, *light*, *nourishment*, *air*, the circulation of the blood, and the *nervous stimuli*. So long as the action of these stimuli is in proportion to the degree of irritability of the system, and the sum of their action is nearly equal to the sum of the irritable principle, (*oxygen*), absorbed by the lungs,

lungs, and distributed by the circulation, the whole system will be in proper order, and the fibres will have their tone. When one of these stimuli acts more powerfully than ordinary, or the fibre becomes more irritable, while the degree of accumulation of the stimuli remains the same, the *exhaustion* of the system, and one of these diseases in its train, will be the consequence. The absence of one or more of these stimuli will produce *accumulation* of irritability in the system, and give birth to one of the diseases of this class.

Heat of the atmosphere and all surrounding bodies, acts upon the fibre, and stimulates it, and gives life to both animals and vegetables.

Light is another common stimulus.

Nutriment is the third common stimulus. It requires a very small quantity to supply the daily losses.

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The *circulation of the fluids* is the most powerful of the common stimuli. The blood which *oxygenates* itself during its passage through the lungs, being decomposed, parts with its oxygen in the circulation, during which the caloric separates : hence the animal heat.

The stimulus of generation in some animals and plants, is so great, that it is irreparably exhausted by the stimulus of the propagation of the species ; so that they die the moment the work of generation is finished.

The *nervous stimulus* is the only one which is peculiar to animals. It is this stimulus which is the cause of the voluntary motions, of convulsions, and passions. The passions differ from one another only in stimulating the irritable fibre more or less. Anger and joy are very powerful degrees of the nervous stimulus ; content and hope are weak degrees ; fear, sorrow, fright, despair, are

are not absolute degrees of stimulus ; they are only the abstraction of the stimuli of hope, content, and happiness. Anger and joy act as very powerful stimuli, and exhaust the irritability of the fibre, in the same manner as any other stimulus whatever. Content and hope are degrees of the nervous stimuli, necessary to preserve the tone of the fibre. If they continue to act, the irritability of the fibre accumulates. It is well known that fearful and melancholy persons are oftener affected by the stimulus of contagious diseases, than those who are free from fear, and who take the precaution of applying a greater quantity of stimuli than ordinary to their fibres ; by taking wine, vinegar, opium, bark, &c. Cold is a negative stimulus ; it is one of the powers of nature, and counteracts heat ; its effects on the irritable fibre, are in proportion to the *habit*, or the quantity which is necessary for the fibre to preserve its tone. The animals and plants
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of hot climates, that require the stimulus of great heat to preserve the tone of their less irritable fibres, are affected by the least abstraction of this habitual stimulus ; the irritability of their fibres accumulates in consequence of this abstraction, and the return of the heat again exhausts the fibre. The more intense the cold is, the greater the accumulation of irritability. — After the fibre has been exposed for some time to a great degree of cold, its irritability is encreased to such a degree, that the most trifling degree of heat produces the most violent effects ; hence the glow experienced in coming out of a cold bath ; hence the diseases which are caught in coming out of the cold air into a warm room. It is by the gradual application of heat, that frozen limbs can be recovered, and it is necessary always to begin by rubbing them with snow ; without this, the fibre will be exhausted, and become gangrenous. During the winter, by the ab-

fence of the stimulus of heat, and in part of light, plants, and many animals, become torpid, the organs of circulation and of nutrition perform their functions but languidly, and life itself appears suspended. In consequence of the diminished action of these stimuli, the irritability accumulates, and manifests itself at the return of spring. The least degree of heat then produces the most violent effects upon the fibres, thus delicately irritable. Vegetation is much more vigorous in spring time, than during the rest of the year; it diminishes during the summer, in proportion as the irritability accumulated during the winter, is diminished by the action of heat and light; and lastly, is exhausted in the autumn.

By the abstraction of many of the stimuli, for any length of time, the irritability of the fibre accumulates so much, that the most trifling stimulus produces the most violent effects, and
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frequently instantaneous death. The cure of this direct debility, should be begun with the smallest doses of the diffusible stimuli, such as opium, wine, &c. and then rise greater and greater, till the morbid abundance of excitability be gradually worn off, and the health restored.

In every degree of debility, the high force of the passions that produces indirect debility, must be avoided. And it must not be forgot, that a very small degree of them is sufficient for that effect. This excitability proceeds with such rapidity to death, that the only means of restoring health is, first to make use of a very small dose of diffusible stimulus, then, after wasting a part of the superabundance, to proceed to a somewhat stronger dose of the stimulus, and in that manner to be constantly taking off whatever superfluity still remains, till at last the salutary mediocrity is regained. Thus, a famished per-

son is not immediately to be gratified with a full meal, a person afflicted with a long duration or high degree of thirst, is not immediately to be indulged with a large draught.—To the former should be given bit by bit, to the latter drop by drop; then, after a time, more plentifully; and to a person benumbed with cold, heat should be gradually applied. Every person thoroughly penetrated with grief, sorrow, or any high dejection of mind, should have good news gradually communicated to them. All these are on the same footing, and equal instances of an excitability too accumulated to bear any degree of stimulus. All quick transitions from one opposite to another, should be avoided.

ON

ON DISEASES IN GENERAL.

SECTION II.

In treating on the causes and cure of the diseases of both animals and vegetables, we shall find that axiom of Sir Isaac Newton, as necessary in physic as philosophy, *viz.* that *the causes only that are true, and sufficient to explain phenomena, are to be admitted into any science.*

Thus, by this rule we have reduced all diseases to two genera, *viz.* that of exhaustion or *stenic*, and that of accumulation or *astenic*, without any other difference but what consists merely in degree. As these two diseases are as opposite as heat and cold, so the increase of the powers which caused the first, is a cure for the last; in the first, to diminish the stimulus or excitement,
and

and in the latter, to increase it to the degree of health.

The power producing a predisposition of the body to stenic diathesis, or diseases of exhaustion, proceeds from too great a quantity of stimuli; while astenic diseases proceed from too great an accumulation of the irritable principle owing to the abstraction of stimuli.

Heat is the power which stimulates animals and vegetables, and necessary for the production and growth of both. By its action on the surface of the body it stimulates the whole; from this action of heat there is no exception, when it keeps within a certain degree; but when it is deficient, or cold is too much increased, its effects varies accordingly; for health is a state within due bounds of heat and cold; for when heat or cold are too predominant, disease will follow.

Cold, to a greater degree than the
animal

animal heat requires to the production of health, is prejudicial to both animals and vegetables; and when excessive, equally, as excessive heat, produces laxity in the vessels, debility, gangrene, &c. Debility proceeds from the extremes of temperature of both heat and cold.

Cold, according to the various degrees of it, produces health; it stops the want of excitability; makes the body more susceptible of stimulant operations; checks the progress of *indirect* debility; abates the career of heat, and other stimuli, which accelerate *indirect* debility, and keeps the excitement within the bounds of vigour.—Hence the vigour in cold countries; hence the bracing, by cold, the parts that have been relaxed by heat. This effect of cold is somewhat greater on the surface than in the internal parts. The debilitating effect of temperature is increased by moisture.

Thus

Thus, these two powers, heat and cold, excite all phenomena of life, and produce sometimes an excess; sometimes a just proportion; and sometimes a deficiency of life, according to the various degrees in which they are applied; and the same observations extend to the same powers, when they are applied as remedies of diseases. Thus every disease that the debilitating powers remove, is *stenic*; so every one that is cured by stimulating means, is *asthenic*.

Thus the cause of health and disease is one and the same, *viz. a variation of excitement*. A certain given degree constitutes health; every increase or diminution of that degree, forms tendency to disease: And when the increase or diminution arises to a certain height, its consequence is actual disease. Hence the cause of disease and the cure are performed by the same powers; and the remedies operate by diminishing

ing the excitement when excessive, and increasing it when deficient. This will hold true both in animal and vegetable life. This has therefore laid the foundation of a science which may be called the *science of living matter*, comprehending every modification of life on the terraqueous globe. Thus it may be observed, that the exciting powers operating on vegetables, are the same with those which operate on animals. They are air, heat, cold, and moisture. By the most accurate observations and experiments on diseases, both *stenic* and *asthenic*, it has been discovered that the causes of one disease were the remedies for the other, and *vice versa*. Thus, if we consider the external appearance of disease, independent of the cause, we are often deceived. The whole phenomena of life may be reduced to one simple cause, the *stimulant* powers applied to a certain property of living bodies denominated *excitability*. The cause is always the same in kind in

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every state of the living system, *viz.* *That it is always stimulus operating on excitability.* Thus the phenomena of health and disease are effects flowing from the same cause; and that it is only a variation of it in degree, that produced the difference in effect; that the cause was still excitement, or the result of the exciting powers upon the excitability; and that the effect was the production of the several phenomena of life, sense, motion, intellectual operation and passion. Health arises from a given degree, and predisposition to disease, from an *increase* or *diminution* of the cause, in degrees always proportional.

By a steady observance of the above principles may be discovered the affinity of consumption and dropsy, between mania and peripneumony, between a catarrh and distinct small-pox; and generally rising from partial to more generally assemblages, we may discern,
that

that where-ever excessive vigour prevailed in any concurrence of symptoms, they constituted a case of disease, precisely the same as all other cases where such increase or diminution of the healthy vigour occurred. Hence, as has already been observed, there are only *two* idiopathic diseases; and even these are not produced by powers different in kind, but different only in degree.

To the above account, respecting disease, it may be added, that sometimes a derangement of the solids, as simple and inanimate, or a fault in organization may occur. This may sometimes affect the general system; but whether it does or not, it must be considered as different from idiopathic affection in its causes and mode of cure: these being *local*, while those of disease are general.

A local disease is the immediate hurt to a peculiar part of the body, without

any predisposition or previous complaint; the person being in perfect health immediately before the accident; or it may be still local, when a person is in a bad state of health when it happens; but so that the general state of health is understood to have no concern with it. Thus a wound, a bruise, a laceration to such a person, is always to be considered as the affection of the part, and to be treated accordingly.

Indeed a wound may induce disorder over the general system, but still all the symptoms may be traced to the wound, which produced a solution of continuity in it. Hence an inflammation follows, and it is an universal fact in the animal œconomy, that when any part, whether external or internal, which possesses great sensibility, is wounded, or otherwise injured in its substance, the pain arising from the inflammation spreads symptoms of disorder over the whole system.

General

General diseases are always preceded by predisposition, local never. As, for example, those of the stomach by swallowing glass, fish bones, &c. are local; for the person was in perfect health immediately before the accident: the substances swallowed, were such as naturally divide a sound part, and produce a solution of continuity; hence inflammation, an inseparable consequence.

Having treated of diseases in general, I now proceed to examine them more particularly; by which examination we shall find, that, as the modern chemistry has proved, that Heat and Cold are the two first principles in nature, so we shall now find, that all diseases attending the human body may be classed in two genera, *viz.* Hot and Cold. The first class or order of those are such that proceed from too great a quantity of stimuli, or heat, which brings on a state of exhaustion; these I shall de-

denominate *stenic*: as this disease proceeds, exhaustion follows, from the too great quantity of stimuli. To the second class, or order, I shall give the name *astenic*, or diseases of accumulation, or irritability, from a want of a proper quantity of heat or stimuli.

ON DISEASES,

STENIC OR INFLAMMATORY.

SECTION III.

Having observed thus much on diseases, it seems to follow, that the first thing a physician should do, when he comes to the bedside of a patient, after he has made the necessary enquiries, should be to consider and settle the three following things in his mind:—First, Whether the disease be general or local. Secondly, If general, whether it be *stenic* or *astenic*. Thirdly, What is its degree.—When he is satisfied in these

these three points, all that remains with him to do, is to form his indication, or general view of the plan of cure, and carry that into execution by the administration of proper remedies.

We shall first begin with fevers, of which Dr. Cullen gives the following description, and says, "*Pyrexia*,"* or febrile diseases, are distinguished by the following appearances. After beginning with some degree of cold shivering, they show some increase of heat, and an increased frequency of pulse, with the interruption and disorder of several functions, particularly some diminution of strength in the animal functions."

Synocha, or stenic inflammatory fever.

Before

* *Pyrexia*—Character—*Post horrorem pulsus frequens, calor major, plures functiones laeae, visibus praesertim artuum imminutis.*

Before the attack of this fever, the person generally enjoys the highest state of health; no complaint or symptom of disease is to be perceived till the arrival of the disease itself; the senses are acute, the motions both voluntary and involuntary are vigorous; there is an acuteness of genius, and a great force of sensibility, as well as passion and emotion; the several parts of the body are perceived to be in a state of vigour from the following marks of it: the strength of the heart and arteries is observed from the strong and full pulse; the extreme vessels on the surface from their complexion; all the muscles from the strength they exert; the internal secretions from the great quantity of milk and semen; the digestive organ from the appetite; the digestion, the vigour of the body and the manifest abundance of blood.

The increase of the force of the senses,
of the motions, of the intellectual faculty,

ty, and the passions, depends on the increase of the excitement in every one of the organs; among other actions, quickening the motion of the blood through them.

The coming on of every stenic disease, is begun by a shivering.

In this disease the pulse is stronger, harder, and fuller, and somewhat more frequent than in its sound state: its fulness and hardness are often owing to taking much of animal food, during the predisposition; the force and frequency are occasioned by the same and other stimuli; that of strong drink, that of the diffusive kind, and that of exercise, whether corporeal or mental; and indeed, all the stimulant powers promote the same effects. The redness of the skin, may be explained by not only an over proportion of blood, but also by the vigour of the circulation being increased by the stenic diathesis, which

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may likewise further tend to obstruct the perspiration. The same is the cause of the head-ache, and pains in different parts, which quickly yield to bleeding. And what farther strengthens this is, that the inflammation generally affects the external parts; the delirium also that sometimes arises in a violent state of the disease, yields to bleeding, and other evacuations; and the abundance of blood in the vessels, distending these to excess, is the cause of the whole affair; on the one hand, by the redness of the face; on the other, by bleeding, removing the disease at once. Thirst and heat, which are also remarkable symptoms in the stenic diseases, depend upon the stenic diathesis, in the extreme vessels of the fauces, and the skin; and in this I may probably agree with Dr. Cullen—that his favourite theory of spasm may in some measure contribute, as well as to the obstruction of the perspiration upon the surface of the body; and may not this be likewise the cause
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of the increase of the caloric, which is generated throughout the system at large?

A hoarseness, cough, and expectoration, which are sometimes observed in sthenic diseases, commonly precede and succeed to each other, in the following order: there is first often a hoarseness, then a dry cough; then a cough with expectoration: the cause of the hoarseness and dry cough, is an obstruction of the exhalants and mucous vessels, which terminate in the bronchia*, still occa-

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* The bronchia are the divisions of the wind-pipe, running through the substance of the lungs, and blended with blood vessels. In the substance of the lungs, besides these two sets of vessels, the air vessels and blood vessels, there are likewise exhalants, small arteries, and mucous glands, coming off from the extremities of the red arteries. The wind-pipe is covered with the latter; and the great quantity of mucus thrown up from the lungs, often in perfect health, and in innumerable cases, both of sthenic and asthenic general diseases, sufficiently proves the existence of the source from which it flows.

fioned by a violent stenic diathesis, and prevented from transmitting their contents to lubricate the air vessels, so as that hoarseness may be removed, and the expectoration proceed with freedom.

The expectoration is next freely made, because the diathesis being now diminished, the ends of the vessels become relaxed, and the fluids are poured out in abundance upon the air vessels; they produce a commotion of the excitability over this whole organ, and by the convulsive motion, which is called *cough*, are themselves thrown out.

As the greater freedom of expectoration now implies an abatement of the diathesis, so too great a flow, and too long a continuance of it, shews, that the diathesis is now rapidly proceeding to the *asthenic state*, either from *indirect* debility, as when the disease in its progress has much exhausted the excitability,

bility, (or oxygen); or from *direct* debility, as when the proper plan of cure has been pushed beyond the proper bounds.

Cure of an Inflammatory FEVER.

1st. As a plethora is frequently the fore-runner of a stenic diathesis, so bleeding is the most powerful remedy of all others, being that which completely carries off a stimulus; much more powerful than any other, as it is directly applied to a greater extent over the whole system; consequently as often as the diathesis is too high, so frequently should it be repeated.

This remedy, however, should never be risked during the predisposition, nor hardly ever hazarded in diseases of a gentle nature; and under such circumstances, I have no doubt, but that other remedies might be more valuable.

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The next remedy of importance to *bleeding*, when heat and other stimuli are guarded against, is cold. Heat is always hurtful, and still more so after a previous application of cold ; but it is most hurtful, when it is also combined with other excessive stimulant powers : cold is always of service, and in proportion to its degree, provided foreign stimuli, blended with it, and overcoming its debilitating effect, be cautiously shunned.

Cold may be employed to diminish the activity of the whole body, and particularly that of the sanguiferous system.

Heat is the chief support of the activity of the animal system ; which is therefore provided in itself with a power of generating heat. But, at the same time, we observe, that this would go to excess, were it not constantly moderated by a cooler temperature in the surrounding

rounding atmosphere. When, therefore, that power of the system generating heat is increased, as is commonly the case, in fevers; it is necessary not only to increase the degree of cold, but it seems proper also to apply it more entirely and freely than in a state of health.

Some late experiments in the small-pox, and in continued fevers, show that the free admission of cool air to the body is a powerful remedy in moderating the violence of action and reaction; but this requires the greatest caution, when and how used.

The next in rank, after these remedies, is the action of vomiting, purging, and sweating. These evacuations have a powerful effect in removing the stenic diathesis, and therefore do they, with great advantage, supercede the more often *imagined*, than *real*, necessity of pro-

profuse bleeding: these are often alone sufficient to restore the healthy state.

Together with all these, the articles of diet, (the stimulant operation of which prevents the benefits to be received from them), should be sparingly used; and that in *exact* proportion to the degree of the diathesis. This precaution alone, may be adequate to the removal of predisposition, and often to that of the disease, especially when the inflammatory symptoms are moderate.

To all the remedies yet mentioned, we must subjoin that of Rest, when the diseased state has taken place; and even moderation in motion during the period of predisposition; for the stimulus of exercise may of itself alone be sufficient to effect the conversion of the predisposition into the actual diseased state. The highest of these diseases, even the peripneumony itself, has been brought on by violent exertion in exercise.

ercise. In these cases, the depending upon any one remedy, and overlooking all the rest, is a bad practice; we must not depend on bleeding alone, not even in peripneumony itself.

There are two other external applications often made use of, *viz. blistering* and warm *bathing*.

As to blistering, I think Dr. Cullen's account of it is so much to the purpose, that I shall give it in his own words: "The effects of blistering, so frequently made use of in fevers, is not yet agreed upon among physicians; and many different opinions have been maintained on this subject, drawn not only from reasoning, but also from *presumed* experience. I must not, however, enter into the controversy; but shall deliver my own opinion in a few words.

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“ I am persuaded,” says he, “ that the small quantity of cantharides absorbed from a blistering plaster, is not sufficient to change the consistence of the mass of blood, by resolving the phlogistic lentor, if it exists; nor do harm, by increasing the dissolution of the blood, arising from a putrid tendency in it. I therefore *neglect* entirely the effects of cantharides upon the fluids.

“ The inflammation produced by the application of cantharides to the skin, affords a certain proof of their stimulant power; but in many persons, the effect of that stimulus is not considerable: in many, it is not communicated to the whole system; and even when the effect does take place in the whole system, it seems to be taken off very entirely, by the effusion and evacuation of serum from the blistered parts: I conclude, therefore, that neither much
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good is to be expected, nor much harm to be apprehended, from the stimulant power of blistering.

“ Much has been imputed to the evacuation occasioned by blistering; but it is never so considerable as to affect the whole system; and therefore can neither, by a sudden depletion, relax the sanguiferous vessels, nor by any revulsion, effect the general distribution of fluids.

“ The evacuation, however, is so considerable as to affect the neighbouring vessels; and the manifest utility of blistering near the part affected, in inflammatory diseases, leads me to believe that blistering, by deriving to the skin, and producing an effusion there, relaxes the spasm of the deeper seated vessels. I apprehend it to be in this manner, that the tumor of a joint, from an *effusion into the cellular texture* under the skin,

takes off the rheumatic pain affecting that joint."

This appears to be a just account of the operation of cantharides, which seems to affect the habit of body in the same manner as a hot iron or volatile alkali will do ; they raise the cuticle from the cutis, and thereby open a discharge of any offending matter that may be lodged in the cellular membrane, and thus relieve in some diseases of the joints, &c.

In high putrid fevers with delirium, I think I have observed a bad effect from continuing a blister on the head ; the symptoms I have often seen aggravated, and death has followed ; which has made me always cautious in applying blisters to the head of such a person, lest the acrid salts of the cantharides should stimulate the vessels of the head, and thereby increase the disease.

From

From what has been observed, it will appear, that the part of the body to which blisters ought to be applied, is indifferent, excepting upon the suspicion of topical affection; when the blistering ought to be made as near as possible to the part affected.

“ * The other external means of taking off the spasm of the extreme vessels, is warm bathing; the heat of the bath stimulates the extreme vessels, and with the concurrence of moisture, also relaxes them; it seems to be a safe stimulus, and well suited to take off the spasm affecting them.

“ It may be applied to the whole body by immersion; but this is in many respects inconvenient; but whether some of the inconveniencies of immersion might not be avoided by a vapour bath, I have

* Dr. Cullen upon Fevers, vide page 179, vol. I.

I have not yet learned from experience; I know, however, from *much experience*, that most of the purposes of warm bathing can be obtained by a fomentation of the legs, in water as warm as they can bear, and continued for a due length of time, which ought not to be less than an hour; the marks of the good effects of such fomentation or bathing, are the patients bearing it easily, its relieving delirium, and inducing sleep."

Throughout this disease, attention should be given to food and liquors; the food should be of the farinaceous kind, and taken in a liquid form, as water-gruel, rice gruel, &c. animal food of all kinds should be abstained from, even soups and broth; liquids, such as a decoction of barley or oatmeal; water wherein a roasted apple has been infused, or a small quantity of tamarinds;
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may be drank with the greatest freedom.

There is also another circumstance which ought to be considered with circumspection ; that is, the air in which the person breathes, and is surrounded ; the room wherein he is, should be as large and airy as may be ; the windows and door should be open, for the admittance of a proper quantity of cold air ; but little light, and no wind ; as light always acts as a stimulus ; for this purpose, blinds of very thin canvass or lawn, should be placed before the openings of the door and windows, such as may prevent the wind, but admit the cold air to be forced through them ; in this manner, the coldness of the air should be admitted to such a degree as to force off the *carbonic* effluvia, thrown off from the lungs during respiration, as well as by the exhalants upon the surface of the body ; but not in so violent
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a degree, as to suffer them to fall into a state of contraction ; for were that to be the case, it would increase and not lessen the fever.

As fire in action is the great consumer of air, so it is proper a fire should be made in some part of the room ; but at as great a distance as may be from the diseased person, the heat of which should be prevented from coming to him as much as possible by a good screen being placed between him and the fire ; by this means the cold air will be admitted into the room, which will force the foul effluvia through the fire, whose place will be immediately supplied by that which is pure from without ; in this manner the air of the room may be regulated and made pure, by the admission of fresh cold air from without, and the consumption of the foul, by being forced through the fire.

Having

Having now described the diseases of exhaustion or stenic, I shall now point out the following conclusion.

That in the stenic or inflammatory disease, the blood by its quantity, distends the muscular fibres, and this distention of the fibres produces an excitement, called *excitability*. Thus excited, the fibres contract and send the wave of blood forward to another portion: when the wave has passed one portion of fibres, they again relax, and make way for the next; in this manner the circulation of the blood goes on, and this alternate dilatation and contraction continue while life remains. Hence in a vigorous state of the system, the contractions are strong and forcible, and the relaxations active; action and reaction are greatest. Thus the blood acts by its mechanical force, and the fibre resists with vital energy. The exciting causes of this disease are excess in eating, drinking, exposure to heat,

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or to the alternation of heat and cold, an over proportion of blood from inactivity, or an increased velocity of its motion from violent labour, &c.

The cure is to be performed by diminishing the quantity of blood, lessening the energy of all the exciting powers, and by reducing the excessive excitement, by what has been called the antiphlogistic method, to the degree that suits the healthy state, and no farther; for, if this method is carried too far, or continued too long, diseases of debility, as dropfy, &c. are brought on.

If the excitability, which proceeds from oxygen, is exhausted before the disease is cured, the remaining hydrogen and azot, brings on a putrid state in the fluids of the body, for want of oxygen. If this putrid state is not observed soon enough, or not corrected
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by acids, the destruction of the frame must follow *.

After this disease is cured, whether it happens either before or after the putrid state, the patient is generally left in a state of debility ; but this is generally removed and health restored, by giving, at first, small doses of diffusible stimuli, in conjunction with animal soups, then solid meat, the usual diet and the usual way of living.

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* Oxygen, according to the present doctrine of chemistry, having been proved to be the basis of all acidity, may it not follow, that acids in fevers are of service, by furnishing a supply of oxygen to the system, and thereby correct the tendency to putridity ?

ASTENIC DIATHESIS,

OR

*Diseases of Accumulation, or Irritability,
from a Want of Stimuli.*

SECTION IV.

Having treated on diseases of exhaustion or stenic, which proceed from too great a quantity of stimuli, I now proceed to consider those which are occasioned by too great accumulation of oxygen or irritability. Thus, as an over proportion and velocity of the blood are the cause of a stenic diathesis; so there is nothing more powerful in producing the astenic, than a *poverty of blood with the greatest celerity of motion*. This diathesis is accompanied with a smallness, weakness, and quickness of the pulse; resembling that of a new-born infant; a debility, want of appetite; a depraved appetite; wasting of the

the flesh, weakness over the whole system; together with a languor, a lax, and soft fibre. This disease may be brought on or greatly increased by fear, grief, despair, and melancholy; it is often attended with hæmorrhages of blood from the lungs, uterus, nose, urinary passages, and sometimes through the skin by the perspirable arteries.

At the coming on of this diathesis, a sense of cold with shivering is not unusual, attended with a very diminished perspiration, a paleness and dryness of the skin, occasioned by a spasm on the extremities. In these affections, the pulse is weak, small, and very quick; head-ach, sometimes delirium; but this must not be imputed to inflammation, but to a deficiency of stimuli.

There is generally a quickness of the pulse and some morbid inflammatory appearances attending these diseases, particularly at their beginning; but these

these inflammatory symptoms, proceed from debility and an acrimony in the system, and are asthenic, and must be cured by stimulants; bleeding and other evacuations must be abstained from. A previous inflammation of this kind is observed when a gangrene or mortification is coming on; and though the parts are in the greatest debility, as in old age, yet a small inflammation precedes it, from the acrimony of the fluids.

Thirst and heat do also often attend asthenic diseases; this thirst is a frequent affection in these diseases, with a loss of appetite, loathing of food, sickness of stomach, vomiting, and an acute pain in the stomach. These symptoms, as they are also attendants on the sthenic, furnish an instructive instance of the erroneous mode of judging by the nature of symptoms.

The above complaints, under an asthenic diathesis, are from spasm; this is
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occasioned by a relaxation and atony of the fibres, together with the distending matter, or foul crudities in the stomach and hardened excrements in the intestines; the effect of this matter is distention, which does not so much depend upon itself as upon the lax state of the fibres distended by it; for the fibres when strong and vigorous, easily repel the distending powers in that state; but the relax fibres yield more and more, till loosing all power of contraction or relaxation, they continue immovably contracted during such action and suffering; the sensible fibres undergo a certain violence; and hence the pain. These violent pains in the asthenic diathesis, proceed from a poverty of blood, or want of oxygen; whilst pains in the same parts are sometimes occasioned in sthenic diseases, from a strong and full blood, and require an opposite method of cure. What brought on a predisposition to one, will be the cure of the other. Thus, in the sthenic, an anti-phlogistic

phlogistic method to diminish the quantity of blood, and the energy of all the exciting powers; but in the astenic we must make use of opium and other diffusible stimuli and tonics, in conjunction with animal soups, &c.

Diseases of this kind, are removed by wine, aromatics, tonics, and volatile alkali, and above all the rest the various forms of opium; abstaining from all kinds of evacuations. Spasms of this kind often also are troublesome in the external parts of the body, by distention, and often attended with the most exquisite pain, arising from debility, and are to be removed by restoring the strength.

There is another pain often attendant on debility, equally troublesome, which is not occasioned by distention, but by stimulus. This pain proceeds from concentrated acid, which is sometimes predominant in the alimentary canal, when

when under the influence of great debility. This acid is not the primary cause, but only a symptom supervening upon the disease, already formed in consequence of the debility. Among the troublesome symptoms are indigestion, gout, diarrhœa, dysentery, cholera, cholic, iliac passion, chlorosis, tabes, or consumption, and atrophy: sometimes the arms and other parts are tortured with cramps, sometimes the thorax, sometimes the shoulders, sometimes the sides, sometimes the back or neck are affected with pain, from which pains no part of the human body is exempted; the region of the liver, and the stomach are particularly liable to them. These smart pains are often supposed to proceed from internal inflammation, but are in reality owing to spasmodic or convulsive affections, and are effectually removed, by applying rags dipped in laudanum, volatile alkali, or æther, which are to be renewed as often as they become dry. The

system should be supported internally with durable and diffusible stimuli. Friction used over all the affected parts, is also found to be useful in supporting the stimulant operation, of all other remedies. A future return of these disorders is prevented by air, exercise, and other useful stimuli. To distinguish those from pains that flow from inflammation, the concurrence of accompanying symptoms must be attended to.

THE END.



